INSTALLATION RESTORATION PROGRAM

FINAL REPORT

For Site Investigation at the 142nd Fighter Interceptor Group Oregon Air National Guard Portland International Airport Portland, Oregon

Appendices

AIR NATIONAL GUARD

HAZWRAP SUPPORT CONTRACTOR OFFICE
Oak Ridge, Tennessee 37831
Operated by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

FINAL REPORT
FOR SITE INVESTIGATION AT THE 142ND FIGHTER INTERCEPTOR GROUP
OREGON AIR NATIONAL GUARD
PORTLAND INTERNATIONAL AIRPORT
PORTLAND, OREGON

APPENDICES

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APPENDICES

APPENDIX A

CHEMICAL MONITORING DATA

LIST OF DATA QUALIFIERS AND MEANINGS

A - analysis by method of standard additions.

B - analyte was detected in the associated method blank.

C - SPCC or CCC results were outside the RRF or %D limits, respectively.

E - reported concentration exceeded the calibration range; dilution was not run.

HB - analyte was detected in the associated holding blank.

HT - holding time was exceeded for sample extraction and/or analysis.

I - estimated concentration due to use of external instead of internal standard.

J - estimated concentration.

M - matrix spike/matrix spike duplicate results were outside QC limits, or were very low.

S - surrogate recoveries were outside QC control limits.

U - reported as not detected by the laboratory.

US - compound was reported by the laboratory as not detected and the surrogate recoveries were outside QC control limits.

X - analysis data sheet was missing from the lab data report; refer to lab report narrative.

Note: Data qualifiers associated with Field QA/QC are not presented in this appendix. See Chapter 8.0 for a discussion of Field QA/QC data validation.

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1-1-1		SB1-1-2		SB1-2-1		SB1-2-1D SB1-2-1 Repl		SB1-2-2	
Site No.	1		1		1		1		1	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/8/88		12/8/88		12/8/88		12/8/88		12/8/88	
Assoc. Field Blank	F1-1		F1-1		F1-1		F1-1		F1-1	
Assoc. Trip Blank	TB-1		TB-1		TB-1		TB-1		TB-1	
Assoc. Equip. Wash	EW1-1		EW1-1		EW1-1		EW1-1		EW1-1	
Assoc. Method Blank:										
(VOC)	VBDEC15		VBDEC15		VBDEC15		VBDEC15		VBDEC15	
(PCB)	MB003		-		MB003		MB003		-	
(PHC)	MB003		MB004		MB003		MB003		MB004	
Assoc. VOC Hold. Blank	HB29		HB29		HB29		HB29			
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/15/88		12/15/88		12/15/88		12/15/88		12/15/88
Methylene Chloride	0.006	0.013 HB,C	0.007	0.041 HB,C	0.007	0.015 HB,C	0.007	0.012 HB,C	0.007	ND C
Acetone	0.12	ND C	0.14	ND C	0.13	0.17 C	0.13	ND C	0.14	ND C
Other Volatiles	0.006-0.12	ND C	0.007-0.14	ND C	0.007-0.13	ND C	0.007-0.13	ND C	0.007-0.14	ND C
POLYCHLORINATED BIPHENYLS			NA	NA					NA	NA
Date Extracted:		12/21/88				12/21/88		12/21/88		
Date Analyzed:		1/9/89				1/3/89		1/4/89		
Arochlor 1254	0.20	0.34 S,M			0.20	ND	0.21	ND		
Other Isomers	0.20	ND US			0.20	ND	0.21	ND		
PETROLEUM HYDROCARBONS										
Date Extracted:		12/21/88		12/21/88		12/21/88		12/21/88		12/21/88
Date Analyzed:		1/8/89		1/5/89		1/7/89		1/7/89		1/5/89
C10-C24 Aliphatics	22	43 M	2.2	ND	2.4	ND	2.4	ND	2.3	ND

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1-3-1	SB1-3-2	SB1-4-1	SB1-4-2	SB1-5-1
Site No.	1	1	1	1	1
Matrix	Soil	Soil	Soil	Soil	Soil
Date Sampled	12/9/88	12/9/88	12/9/88	12/9/88	12/9/88
Assoc. Field Blank	F1-1	F1-1	F1-1	F1-1	F1-1
Assoc. Trip Blank	TB-2	TB-2	TB-2	TB-2	TB-2
Assoc. Equip. Wash	EW1-1	EW1-1	EW1-1	EW1-1	EW1-1
Assoc. Method Blank:					
(VOC)	VBDEC16	VBDEC16	VBDEC19	VBDEC15	VBDEC19
(PCB)	MB003	-	MB003	-	MB003
(PHC)	MB003	MB004	MB003	MB004	MB003
Assoc. VOC Hold. Blank	HB28	HB28		HB28	

ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/16/88		12/16/88		12/19/88		12/15/88		12/19/88
Methylene Chloride	0.006	0.024 HB,C	0.007	0.072 HB,C	0.006	0.022 B,C	0.007	0.052 HB,C	0.006	0.026 B,C
Acetone	0.12	ND	0.14	ND	0.13	ND	0.13	ND C	0.12	ND
Other Volatiles	0.006-0.12	ND C	0.007-0.14	ND C	0.006-0.13	ND C	0.007-0.13	ND C	0.006-0.12	ND C
POLYCHLORINATED BIPHENYLS			NA	NA			NA	NA		
Date Extracted:		1/10/89				12/21/88				12/21/88
Date Analyzed:		1/12/89				1/4/89				1/4/89
Arochlor 1254	0.072	ND			0.19	ND			0.18	ND
Other Isomers	0.072	ND			0.19	ND			0.18	ND
PETROLEUM HYDROCARBONS										
Date Extracted:		12/21/88		12/28/88		12/21/88		12/28/88		12/21/88
Date Analyzed:		1/10/89		1/5/89		1/06/89		1/5/89		1/7/89
C10-C24 Aliphatics	21	ND	2.3	ND	2.1	ND	2.2	ND	2.1	ND

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station		SB1-5-2		SB1-6-1		SB1-6-2		SB1-7-1		SB1-7-2
Site No.		1		1		1		1		1
Matrix		Soil		Soil		Soil		Soil		Soil
Date Sampled		12/9/88		12/9/88		12/9/88		12/9/88		12/9/88
Assoc. Field Blank		F1-1		F1-1		F1-1		F1-1		F1-1
Assoc. Trip Blank		TB-2		TB-2		TB-2		TB-2		TB-2
Assoc. Equip. Wash		EW1-1		EW1-1		EW1-1		EW1-1		EW1-1
Assoc. Method Blank:										
(VOC)		VBDEC16		VBDEC19		VBDEC19		VBDEC19		VBDEC19
(PCB)		-		MB003		MB003		MB003		-
(PHC)		MB004		MB003		MB003		MB003		MB004
Assoc. VOC Hold. Blank		HB28								
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/16/88		12/19/88		12/19/88		12/19/88		12/19/88
Methylene Chloride	0.006	0.027 HB,C	0.007	0.015 B,C	0.007	0.025 B,C	0.007	0.030 B,C	0.007	0.013 B,C
Acetone	0.12	ND	0.14	ND	0.15	ND	0.14	ND	0.13	ND
Other Volatiles	0.006-0.12	ND C	0.007-0.14	ND C	0.007-0.15	ND C	0.007-0.14	ND C	0.007-0.13	ND C
POLYCHLORINATED BIPHENYLS	NA	NA							NA	NA
Date Extracted:				12/21/88		12/21/88		12/21/88		
Date Analyzed:				1/3/89		1/3/89		1/3/89		
Arochlor 1254			0.22	ND	0.22	ND	0.22	ND		
Other Isomers			0.22	ND	0.22	ND	0.22	ND		
PETROLEUM HYDROCARBONS										
Date Extracted:		12/28/88		12/21/88		12/21/88		12/21/88		12/21/88
Date Analyzed:		1/5/89		1/7/89		1/7/89		1/6/89		1/5/89
C10-C24 Aliphatics	2.0	11	2.5	ND	2.6	ND	2.6	ND	2.4	10

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1-8-1		SB1-8-2		SB1-9-1		SB1-9-2		SB1-9-2R SB1-9-2 Repl	
Site No.	1		1		1		1		1	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/9/88		12/9/88		12/9/88		12/9/88		12/9/88	
Assoc. Field Blank	F1-1		F1-1		F1-1		F1-1		F1-1	
Assoc. Trip Blank	TB-1		TB-2		TB-2		TB-2		TB-2	
Assoc. Equip. Wash	EW1-1		EW1-1		EW1-1		EW1-1		EW1-1	
Assoc. Method Blank:										
(VOC)	VBDEC16		VBDEC16		VBDEC16		VBDEC16		VBDEC16	
(PCB)	MB003		-		MB003		MB003		MB003	
(PHC)	MB003		MB004		MB003		MB003		MB003	
Assoc. VOC Hold. Blank	HB28		HB28		HB28		HB28		HB28	
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/16/88		12/16/88		12/16/88		12/16/88		12/16/88
Methylene Chloride	0.006	0.029 HB,C	0.007	0.037 HB,C	0.007	0.056 HB,C	0.007	0.032 HB,C	0.007	0.016 HB,C
Acetone	0.13	ND	0.14	ND	0.13	ND	0.15	ND	0.15	ND
Other Volatiles	0.006-0.13	ND C	0.007-0.14	ND C	0.007-0.13	ND C	0.007-0.15	ND C	0.007-0.15	ND C
POLYCHLORINATED BIPHENYLS			NA	NA						
Date Extracted:		12/21/88				12/21/88		1/10/89		12/22/88
Date Analyzed:		1/3/89				1/4/89		1/10/89		1/4/89
Arochlor 1254	0.19	ND			0.22	ND	0.086	ND	0.20	ND
Other Isomers	0.19	ND			0.22	ND	0.086	ND	0.20	ND
PETROLEUM HYDROCARBONS										
Date Extracted:		12/21/88		12/28/88		12/21/88		12/21/88		12/21/88
Date Analyzed:		1/6/89		1/5/89		1/6/89		1/10/89		1/7/89
C10-C24 Aliphatics	2.2	ND	2.3	ND	2.6	ND	2.5	ND	2.3	ND

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1-10-1		SB1-10-2		SB1-11-1		SB1-11-2		SB1-12-1	
Site No.	1		1		1		1		1	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/9/88		12/9/88		12/8/88		12/8/88		12/8/88	
Assoc. Field Blank	F1-1		F1-1		F1-1		F1-1		F1-1	
Assoc. Trip Blank	TB-2		TB-1		TB-1		TB-1		TB-1	
Assoc. Equip. Wash	EW1-1		EW1-1		EW1-1		EW1-1		EW1-1	
Assoc. Method Blank:										
(VOC)	VBDEC16		VBDEC16		VBDEC15		VBDEC15		VBDEC15	
(PCB)	-		-		MB003		-		MB003	
(PHC)	MB004		MB004		MB003		MB004		MB003	
Assoc. VOC Hold. Blank	HB28		HB28		HB29		HB29		HB29	
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/16/88		12/16/88		12/15/88		12/15/88		12/15/88
Methylene Chloride	0.006	0.055 HB,C	0.007	0.063 HB,C	0.007	0.029 HB,C	0.007	0.037 HB,C	0.006	0.036 HB,C
Acetone	0.12	ND	0.13	ND	0.14	0.19 C	0.14	ND C	0.13	ND C
Other Volatiles	0.006-0.12	ND C	0.007-0.13	ND C	0.007-0.14	ND C	0.007-0.14	ND C	0.006-0.13	ND C
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA			NA	NA		
Date Extracted:						12/21/88				12/21/88
Date Analyzed:						1/3/89				1/5/89
Arochlor 1254					0.21	ND			0.21	ND
Other Isomers					0.21	ND			0.21	ND
PETROLEUM HYDROCARBONS										
Date Extracted:		12/21/88		12/21/88		12/21/88		12/21/88		12/21/88
Date Analyzed:		1/5/89		1/5/89		1/6/89		1/5/89		1/7/89
C10-C24 Aliphatics	2.0	12 M	2.1	ND	2.5	ND	2.4	ND	2.5	ND

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1-12-2		SB1E-1-1		SB1E-2-1		SB1E-3-1		RE-1 SB1E-3-1 Repl	
Site No.	1		1		1		1		1	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/8/88		1/19/89		1/19/89		1/19/89		1/19/89	
Assoc. Field Blank	F1-1		FBE-1		FBE-1		FBE-1		FBE-1	
Assoc. Trip Blank	TB-1		TBE-1		TBE-1		TBE-1		TBE-1	
Assoc. Equip. Wash	EW1-1		EWE-1		EWE-1		EWE-1		EWE-1	
Assoc. Method Blank:										
(VOC)	VBDEC15		-		-		-		-	
(PCB)	-		MB011		MB011		MB011		MB011	
(PHC)	MB004		-		-		-		-	
Assoc. VOC Hold. Blank	HB29									
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS			NA	NA	NA	NA	NA	NA	NA	NA
Date Analyzed:		12/15/88								
Methylene Chloride	0.007	0.023 HB,C								
Acetone	0.14	ND C								
Other Volatiles	0.007-0.14	ND C								
POLYCHLORINATED BIPHENYLS	NA	NA								
Date Extracted:				1/26/89		1/26/89		1/26/89		1/26/89
Date Analyzed:				2/1/89		2/1/89		2/1/89		2/1/89
Arochlor 1254			0.21	ND	0.22	ND	0.21	ND	0.22	ND
Other Isomers			0.21	ND	0.22	ND	0.21	ND	0.22	ND
PETROLEUM HYDROCARBONS			NA	NA	NA	NA	NA	NA	NA	NA
Date Extracted:		12/21/88								
Date Analyzed:		1/5/89								
C10-C24 Aliphatics	2.3	12								

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1E-4-1		SB1E-11-1		RE-3 SB1E-11-1 Repl		SB1E-16-2		SB1E-17-2	
Site No.	1		1		1		1		1	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	1/19/89		1/26/89		1/26/89		1/26/89		1/24/89	
Assoc. Field Blank	FBE-1								FBE-3	
Assoc. Trip Blank	TBE-1		TBE-3		TBE-3		TBE-3		TBE-2	
Assoc. Equip. Wash	EWE-1		EWE-5		EWE-5		EWE-5		EWE-3	
Assoc. Method Blank:										
(VOC)	-		VBJAN31		VBJAN31		VBJAN31		VBJAN31	
(PCB)	MB011		-		-		-		-	
(PHC)	-		-		-		-		-	
Assoc. VOC Hold. Blank										
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS	NA	NA								
Date Analyzed:				1/31/89		1/31/89		1/31/89		1/31/89
Methylene Chloride			0.007	ND	0.007	ND	0.007	ND	0.007	0.030
Acetone			0.15	ND C	0.15	ND C	0.14	ND C	0.14	ND C
Other Volatiles			0.007-0.15	ND C	0.007-0.15	ND C	0.007-0.14	ND C	0.007-0.14	ND C
POLYCHLORINATED BIPHENYLS			NA	NA	NA	NA	NA	NA	NA	NA
Date Extracted:		1/26/89								
Date Analyzed:		2/1/89								
Arochlor 1254	0.23	ND								
Other Isomers	0.23	ND								
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Date Extracted:										
Date Analyzed:										
C10-C24 Aliphatics										

TABLE A-1S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 SOIL SAMPLES

Sample Station	SB1E-21-2	SMW1E-2-5
Site No.	1	1
Matrix	Soil	Soil
Date Sampled	1/26/89	1/25/89
Assoc. Field Blank		
Assoc. Trip Blank	TBE-3	
Assoc. Equip. Wash	EWE-5	EWE-4
Assoc. Method Blank:		
(VOC)	VBJAN31	VBJAN31
(PCB)	-	-
(PHC)	-	-
Assoc. VOC Hold. Blank		

ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS				
Date Analyzed:		1/31/89		1/31/89
Methylene Chloride	0.007	0.079	0.007	ND
Acetone	0.14	ND C	0.14	ND C
Other Volatiles	0.007-0.14	ND C	0.007-0.14	ND C
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA
Date Extracted:				
Date Analyzed:				
Arochlor 1254				
Other Isomers				
PETROLEUM HYDROCARBONS	NA	NA	NA	NA
Date Extracted:				
Date Analyzed:				
C10-C24 Aliphatics				

TABLE A-1W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 GROUND WATER SAMPLES

Sample Station		MW1-1		R1 MW1-1 Repl		R2 MW1-1 Repl
Site No.		1		1		1
Matrix		Water		Water		Water
Date Sampled		12/21/88		12/21/88		12/21/88
Assoc. Field Blank		FB-4		FB-4		FB-4
Assoc. Trip Blank		TB-4		TB-4		TB-4
Assoc. Equip. Wash		EW-4		EW-4		EW-4
Assoc. Method Blank:						
(VOC)		VBDEC28		-		VBDEC28
(BNA)		MB009		-		MB009
(PCB)		MB007		-		MB007
(Metals)		#1,#2		#1,#2		-
Assoc. VOC Hold. Blank						

ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS			NA	NA		
Date Analyzed:		12/28/88				12/28/88
Methylene Chloride	5	510 S,C			5	480 S,C
Bromochloromethane	20	120,000 I			20	310,000 I
Other Volatiles	5-100	ND US,C			5-100	ND US,C
BASE NEUTRAL/ACID EXTRACTABLES			NA	NA		
Date Extracted:		12/29/88				12/29/88
Date Analyzed:		1/4/89				1/4/89
bis(2-ethylhexyl)phthalate	10	14 B,S			10	27 B,M
Other BNAs	10-50	ND US			10-50	ND
POLYCHLORINATED BIPHENYLS	0.5	ND S	NA	NA	1.0	ND S
Date Extracted:		12/27/88				12/27/88
Date Analyzed:		1/5/89				1/5/89
METALS					NA	NA
Date Prepared:		1/4-13/89		1/4-13/89		
Date Analyzed:		1/5-15/89		1/5-15/89		
Iron	9.6	1200	9.6	970		
Zinc	4.1	14	4.1	ND		
Other Metals	0.3-26	ND	0.3-26	ND		

TABLE A-1W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 GROUND WATER SAMPLES

Sample Station	MW1E-1	RE-2 MW1E-1 Repl	MW1E-2
Site No.	1	1	1
Matrix	Water	Water	Water
Date Sampled	1/19/89	1/20/89	1/27/89
Assoc. Field Blank	FBE-2	FBE-2	
Assoc. Trip Blank	TBE-1	TBE-1	TBE-4
Assoc. Equip. Wash	EWE-1	EWE-1	EW-6
Assoc. Method Blank:			
(VOC)	VBJAN30	VBJAN30	VBJAN31A
(BNA)	-	-	-
(PCB)	-	-	-
(Metals)	-	-	-
Assoc. VOC Hold. Blank			

ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		1/30/89		2/2/89		1/31/89
Methylene Chloride	5	1,500 S	250	2,400 S	5	ND
Bromochloromethane	10	140,000 I	500	110,000 I	10	ND
Other Volatiles	5-100	ND US,C	250-5,000	ND US	5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
METALS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Iron						
Zinc						
Other Metals						

TABLE A-TW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 1 GROUND WATER SAMPLES

Sample Station	RE-4 Rerun MW1E-2 Repl
Site No.	1
Matrix	Water
Date Sampled	1/27/89
Assoc. Field Blank	
Assoc. Trip Blank	TBE-4
Assoc. Equip. Wash	EW-6
Assoc. Method Blank:	
(VOC)	NR
(BNA)	-
(PCB)	-
(Metals)	-
Assoc. VOC Hold. Blank	

ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS		
Date Analyzed:		1/31/89
Methylene Chloride	NR	ND X
Bromochloromethane	10	ND X
Other Volatiles	NR	ND X,C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA
Date Extracted:		
Date Analyzed:		
bis(2-ethylhexyl)phthalate		
Other BNAs		
POLYCHLORINATED BIPHENYLS	NA	NA
Date Extracted:		
Date Analyzed:		
METALS	NA	NA
Date Prepared:		
Date Analyzed:		
Iron		
Zinc		
Other Metals		

TABLE A-2S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 2 SOIL SAMPLES

Sample Station	SB2-1-1		SB2-1-2		SB2-2-1		SB2-2-2		SB2-3-1	
Site No.	2		2		2		2		2	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/13/88		12/13/88		12/13/88		12/13/88		12/13/88	
Assoc. Field Blank	FB2-1		FB2-1		FB2-1		FB2-1		FB2-1	
Assoc. Trip Blank	TB-3		TB-3		TB-3		TB-3		TB-3	
Assoc. Equip. Wash	EW2-1		EW2-1		EW2-1		EW2-1		EW2-1	
Assoc. Method Blank: (VOC)	VBDEC20		VBDEC21		VBDEC20		VBDEC20		VBDEC20	
Assoc. VOC Hold. Blank										
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/20/88		12/21/88		12/20/88		12/20/88		12/20/88
Methylene Chloride	0.007	ND C	0.007	ND C	0.007	ND C	0.007	ND C	0.007	ND C
Other Volatiles	0.007-0.14	ND C	0.007-0.14	ND C	0.007-0.13	ND C	0.007-0.14	ND C	0.007-0.14	ND C

TABLE A-2S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 2 SOIL SAMPLES

Sample Station	SB2-3-2		SB2-4-1		SB2-4-1R SB2-4-1 Repl		SB2-4-2	
Site No.	2		2		2		2	
Matrix	Soil		Soil		Soil		Soil	
Date Sampled	12/13/88		12/13/88		12/13/88		12/13/88	
Assoc. Field Blank	FB2-1		FB2-1		FB2-1		FB2-1	
Assoc. Trip Blank	TB-3		TB-3		TB-3		TB-3	
Assoc. Equip. Wash	EW2-1		EW2-1		EW2-1		EW2-1	
Assoc. Method Blank: (VOC)	VBDEC20		VBDEC20		VBDEC20		VBDEC20	
Assoc. VOC Hold. Blank								
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS								
Date Analyzed:		12/20/88		12/20/88		12/20/88		12/20/88
Methylene Chloride	0.007	0.011 C	0.007	0.010 C	0.007	ND C	0.007	ND C
Other Volatiles	0.007-0.13	ND C	0.007-0.14	ND C	0.007-0.14	ND C	0.007-0.14	ND C

TABLE A-2W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 2 GROUND WATER SAMPLES

Sample Station	MW2-1		MW2-2-1		D-8 MW2-2-1 Repl	
Site No.	2		2		2	
Matrix	Water		Water		Water	
Date Sampled	12/21/88		8/28/89		8/28/89	
Assoc. Field Blank	FB-4		FB8		FB8	
Assoc. Trip Blank*	TB-4		89022413		89022413	
Assoc. Equip. Wash	EW-4		EW9		EW9	
Assoc. Method Blank:						
(VOC)	VBDEC27A		VBSEP7		VBSEP7	
(PHC)	MB008		15MB12		15MB12	
(Metals)	#1,#2		1&2,5&6		1&2,5&6	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		12/27/88		9/7/89 HT		9/7/89 HT
1,2-dichloroethenes	5	130 C	5	28	5	29
Trichloroethene	5	710	5	430	5	470
Other Volatiles	5-100	ND C	5-10	ND C	5-10	ND C
PETROLEUM HYDROCARBONS						
Date Extracted:		12/28/88		9/8/89		9/8/89
Date Analyzed:		1/6/89		9/16/89		9/16/89
C10-C24 Aliphatics	50.0	ND	13.0	ND	13.0	ND M
METALS						
Date Prepared:		1/4-13/89		9/8-28/89		9/8-28/89
Date Analyzed:		1/5-15/89		9/15-10/4/89		9/15-10/4/89
Cadmium	0.3	0.44	0.080	0.36	0.080	0.61
Chromium, Total	12	ND	5.9	ND	5.9	7.0
Iron	9.6	ND	NA	NA	NA	NA
Lead	1.1	ND	1.1	3.7 A	1.1	4.0 A
Nickel	26	ND	14	ND	14	ND
Zinc	4.1	10	5.9	16	5.9	14

TABLE A-3S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 3 SOIL SAMPLES

Sample Station	SB3-1-1		SB3-1-2		SB3-2-1		SB3-2-1R SB3-2-1 Repl		SB3-2-2	
Site No.	3		3		3		3		3	
Matrix	Soil		Soil		Soil		Soil		Soil	
Date Sampled	12/13/88		12/20/88		12/13/88		12/13/88		12/20/88	
Assoc. Field Blank	FB3-1		FB-4		FB3-1		FB3-1		FB-4	
Assoc. Trip Blank	TB-3		TB-3		TB-3		TB-3		TB-3	
Assoc. Equip. Wash	EW3-1		EW-4		EW3-1		EW3-1		EW-4	
Assoc. Method Blank:										
(VOC)	VBDEC21		VBDEC27		VBDEC21		VBDEC21		VBDEC27	
(PHC)	MB006		MB006		MB006		MB006		MB006	
Assoc. VOC Hold. Blank										
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		12/21/88		12/27/88		12/21/88		12/21/88		12/27/88
Methylene Chloride	0.006	ND C	0.007	ND C	0.007	ND C	0.007	0.041 C	0.007	ND C
Other Volatiles	0.006-0.13	ND C	0.007-0.14	ND C	0.007-0.15	ND C	0.007-0.13	ND C	0.007-0.15	ND C
PETROLEUM HYDROCARBONS										
Date Extracted:		12/27/88		12/27/88		12/27/88		12/27/88		12/27/88
Date Analyzed:		1/10/89		1/8/89		1/8/89		1/8/89		1/8/89
C10-C24 Aliphatics	1.8	ND	2.0	2.0 B	1.8	ND	1.8	ND	2.2	ND

TABLE A-3S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 3 SOIL SAMPLES

Sample Station	SB3-3-1		SB3-3-2		SB3-4-1		SB3-4-2	
Site No.	3		3		3		3	
Matrix	Soil		Soil		Soil		Soil	
Date Sampled	12/13/88		12/20/88		12/13/88		12/20/88	
Assoc. Field Blank	FB3-1		FB-4		FB3-1		FB-4	
Assoc. Trip Blank	TB-3		TB-3		TB-3		TB-3	
Assoc. Equip. Wash	EW3-1		EW-4		EW3-1		EW-4	
Assoc. Method Blank:								
(VOC)	VBDEC21		VBDEC27		VBDEC21		VBDEC27	
(PHC)	MB006		MB006		MB006		MB006	
Assoc. VOC Hold. Blank								
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS								
Date Analyzed:		12/21/88		12/27/88		12/21/88		12/27/88
Methylene Chloride	0.006	ND C	0.007	0.026 B,C	0.007	ND C	0.008	0.017 B,C
Other Volatiles	0.006-0.12	ND C	0.007-0.15	ND C	0.007-0.14	ND C	0.008-0.15	ND C
PETROLEUM HYDROCARBONS								
Date Extracted:		12/27/88		12/27/88		12/27/88		12/27/88
Date Analyzed:		1/8/89		1/8/89		1/8/89		1/8/89
C10-C24 Aliphatics	1.7	ND	2.0	ND	1.7	ND	2.3	ND

TABLE A-3W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 3 GROUND WATER SAMPLES

Sample Station	MW3-1		R-3 MW3-1 Repl	
Site No.	3		3	
Matrix	Water		Water	
Date Sampled	12/21/88		12/21/88	
Assoc. Field Blank	FB-4		FB-4	
Assoc. Trip Blank	TB-4		TB-4	
Assoc. Equip. Wash	EW-4		EW-4	
Assoc. Method Blank:				
(VOC)	VBDEC22		VBDEC27A	
(PHC)	MB008		MB008	
Assoc. VOC Hold. Blank				
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS	5-100	ND C	NA	NA
Date Analyzed:		12/22/88		
PETROLEUM HYDROCARBONS				
Date Extracted:		12/28/88		12/28/88
Date Analyzed:		1/6/89		1/6/89
C10-C24 Aliphatics	100.00	ND	50.00	ND

TABLE A-4S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 4 SEDIMENT SAMPLES

Sample Station	S4-1		S4-2		S4-3		S4-4		S4-5	
Site No.	4		4		4		4		4	
Matrix	Sediment		Sediment		Sediment		Sediment		Sediment	
Date Sampled	8/16/89		8/16/89		8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB5		FB5		FB5		FB5		FB5	
Assoc. Trip Blank	TB#01		TB#01		TB#01		TB#01		TB#01	
Assoc. Equip. Wash	EW5		EW5		EW5		EW5		EW5	
Assoc. Method Blank:										
(VOC)	VBAUG25		VBAUG23		VBAUG23		VBAUG23		VBAUG23	
(PHC)	15MB09		15MB09		15MB09		15MB09		15MB09	
(Metals)	1&2		1&2		1&2		1&2		1&2	
Assoc. VOC Hold. Blank	HB74		HB74		HB74		HB74		HB74	
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS										
Date Analyzed:		8/25/89		8/23/89		8/23/89		8/23/89		8/23/89
Methylene Chloride	2.90	ND HB	0.008	0.008 HB	0.010	0.018 HB	0.007	0.008 HB	0.007	0.011 HB
Acetone	5.70	ND C	0.015	0.26	0.020	0.32	0.013	0.14	0.014	0.26
Other Volatiles	2.90-5.70	ND C	0.008-0.015	ND	0.010-0.020	ND	0.007-0.013	ND	0.007-0.014	ND
PETROLEUM HYDROCARBONS										
Date Extracted:		9/6/89		9/6/89		9/6/89		9/6/89		9/6/89
Date Analyzed:		9/12/89		9/12/89		9/12/89		9/13/89		9/13/89
C10-C24 Aliphatics	0.65	25.00 S	0.70	0.97	0.92	6.30	0.59	4.60	0.61	2.00
METALS										
Date Prepared:		9/6-8/89		9/6-8/89		9/6-8/89		9/6-8/89		9/6-8/89
Date Analyzed:		9/14&10/3/89		9/14&10/3/89		9/14&10/3/89		9/14&10/3/89		9/14-10/4/89
Cadmium	0.01	1.6	0.01	0.44	0.012	2.9	0.0088	0.26	0.0081	0.65
Chromium, Total	2.4	35	3.3	26	3.7	28	2.6	9.6	2.7	11
Lead	0.053	41 B	0.054	13 B	0.063	58 B	0.046	7.1 B	0.042	6.9 B
Nickel	0.99	120	1.3	24	1.5	16	1.1	9.3	1.1	8.0
Zinc	5.1	120	7.0	83	7.7	330	5.5	68	5.7	120

TABLE A-4S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 4 SEDIMENT SAMPLES

Sample Station	S4-6	D1 S4-6 Repl	S4-7
Site No.	4	4	4
Matrix	Sediment	Sediment	Sediment
Date Sampled	8/15/89	8/16/89	8/16/89
Assoc. Field Blank	FB5	FB5	FB5
Assoc. Trip Blank	TB#01	TB#01	TB#01
Assoc. Equip. Wash	EW5	EW5	EW5
Assoc. Method Blank:			
(VOC)	VBAUG25	VBAUG25	VBAUG25
(PHC)	15MB09	15MB09	15MB09
(Metals)	1&2	1&2,5&6	1&2
Assoc. VOC Hold. Blank	HB76	HB76	HB76

ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/25/89		8/25/89		8/25/89
Methylene Chloride	0.006	ND M,HB	0.006	ND HB	0.045	ND HB
Acetone	0.013	ND M,C	0.013	ND C	0.089	ND C
Other Volatiles	0.006-0.013	ND C	0.006-0.013	ND C	0.045-0.089	ND C
PETROLEUM HYDROCARBONS						
Date Extracted:		9/6/89		9/6/89		9/6/89
Date Analyzed:		9/13/89		9/13/89		9/13/89
C10-C24 Aliphatics	0.58	0.58	0.57	ND	0.79	10.00
METALS						
Date Prepared:		9/6-8/89		9/6-22/89		9/6-8/89
Date Analyzed:		9/14&10/4/89		9/14&10/4/89		9/14&10/4/89
Cadmium	0.0095	0.27	0.0087	0.29	0.013	1.1
Chromium, Total	2.6	6.4	2.4	7.5	3.4	20
Lead	0.05	4.0 B	0.05	3.7 A	0.066	42 B
Nickel	1.0	5.7	0.99	7.2	1.4	12
Zinc	5.4	59	5.1	64	7.3	76

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-1-1		SB5-1-2		SB5-2-1	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG28		VBAUG28		VBAUG28	
(BNA)	15MB03		15MB03		15MB03	
(PHC)	-		-		-	
(Metals)	1&2		1&2		1&2	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/28/89		8/28/89		8/28/89
Methylene Chloride	0.007	ND	0.007	ND	0.006	ND
Acetone	0.013	ND C	0.014	ND C	0.012	ND C
Total Xylenes	0.007	ND	0.007	ND	0.006	ND
Benzene	0.007	ND	0.007	ND	0.006	ND
Ethylbenzene	0.007	ND	0.007	ND	0.006	ND
Other Volatiles	0.007-0.013	ND C	0.007-0.014	ND C	0.006-0.012	ND C
BASE NEUTRAL/ACID EXTRACTABLES						
Date Extracted:		8/28/89		8/28/89		8/28/89
Date Analyzed:		9/8/89		9/12/89		9/12/89
bis(2-ethylhexyl)phthalate	0.42	0.99	0.44	ND	0.41	ND
Other BNAs	0.42-2.00	ND	0.44-2.10	ND	0.41-2.00	ND
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
C10-C24 Aliphatics						
METALS						
Date Prepared:		9/6-8/89		9/6-8/89		9/6-8/89
Date Analyzed:		9/14&10/4/89		9/14&10/4/89		9/14&10/4/89
Cadmium	0.0086	0.68	0.0081	0.32	0.0085	1.6
Chromium, Total	2.6	30	2.6	29	2.4	30
Iron	3.7	30,000	3.7	31,000	3.4	32,000
Lead	0.045	37 B	0.042	12 B	0.044	34 B
Nickel	1.1	22	1.1	22	0.99	28
Zinc	5.6	130	5.5	86	5.1	160

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-2-2		SB5-3-1		SB5-3-2	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG28		VBAUG28		VBAUG29	
(BNA)	15MB03		15MB03		15MB03	
(PHC)	-		-		-	
(Metals)	1&2		1&2		1&2	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/28/89		8/28/89		8/29/89
Methylene Chloride	0.007	ND	0.006	0.008	0.007	ND
Acetone	0.014	ND C	0.013	0.14 C	0.014	0.038 C
Total Xylenes	0.007	ND	0.006	ND	0.007	ND
Benzene	0.007	ND	0.006	ND	0.007	ND
Ethylbenzene	0.007	ND	0.006	ND	0.007	ND
Other Volatiles	0.007-0.014	ND C	0.006-0.013	ND C	0.007-0.014	ND C
BASE NEUTRAL/ACID EXTRACTABLES						
Date Extracted:		8/28/89		8/28/89		8/28/89
Date Analyzed:		9/12/89		9/20/89		9/13/89
bis(2-ethylhexyl)phthalate	0.43	ND	0.41	ND	0.44	0.23 J
Other BNAs	0.43-2.10	ND	0.41-2.00	ND	0.44-2.10	ND
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
C10-C24 Aliphatics						
METALS						
Date Prepared:		9/6-8/89		9/6-8/89		9/6-8/89
Date Analyzed:		9/14&10/4/89		9/14&10/4/89		9/14&10/4/89
Cadmium	0.0087	0.58	0.0086	0.66	0.0089	0.30
Chromium, Total	2.6	24	2.6	27	2.5	25
Iron	3.7	31,000	3.6	30,000	3.4	30,000
Lead	0.045	19 B	0.045	8.6 B	0.046	13 B
Nickel	1.1	16	1.0	23	0.99	21
Zinc	5.5	80	5.4	80	5.2	62

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-4-1		SB5-4-2		SB5-5-1	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG29		VBAUG29		VBAUG29	
(BNA)	15MB03		15MB05		15MB05	
(PHC)	-		-		-	
(Metals)	1&2		1&2		1&2	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/29/89		8/29/89		8/29/89
Methylene Chloride	0.006	ND	0.007	ND	0.006	ND
Acetone	0.013	ND C	0.014	ND C	0.013	0.035 C
Total Xylenes	0.006	ND	0.007	ND	0.006	ND
Benzene	0.006	ND	0.007	ND	0.006	ND
Ethylbenzene	0.006	ND	0.007	ND	0.006	ND
Other Volatiles	0.006-0.013	ND C	0.007-0.014	ND C	0.006-0.013	ND C
BASE NEUTRAL/ACID EXTRACTABLES						
Date Extracted:		8/28/89		8/29/89		8/29/89
Date Analyzed:		9/13/89		9/12/89		9/12/89
bis(2-ethylhexyl)phthalate	0.42	0.28 J	0.43	0.63	0.41	ND
Other BNAs	0.42-2.00	ND	0.43-2.10	ND	0.41-2.00	ND
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
C10-C24 Aliphatics						
METALS						
Date Prepared:		9/6-8/89		9/6-8/89		9/6-8/89
Date Analyzed:		9/14&10/4/89		9/14&10/4/89		9/14&10/4/89
Cadmium	0.0084	1.9	0.0084	0.58	0.0080	2.9
Chromium, Total	2.4	24	2.6	25	2.3	24
Iron	3.4	29,000	3.7	30,000	3.3	27,000
Lead	0.044	73 B	0.044	21 B	0.042	35 B
Nickel	0.97	20	1.1	34	0.94	22
Zinc	5.0	110	5.5	79	4.9	150

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-5-2		D2 SB5-5-2 Repl		SB5-6-1	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG29		VBAUG29		VBAUG29	
(BNA)	15MB05		15MB03		15MB05	
(PHC)	-		-		-	
(Metals)	1&2		1&2		1&2	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/29/89		8/29/89		8/29/89
Methylene Chloride	0.007	ND	0.007	0.007	0.006	ND
Acetone	0.014	0.023 C	0.014	0.092 C	0.012	0.070 C
Total Xylenes	0.007	ND	0.007	ND	0.006	ND
Benzene	0.007	ND	0.007	ND	0.006	ND
Ethylbenzene	0.007	ND	0.007	ND	0.006	ND
Other Volatiles	0.007-0.014	ND C	0.007-0.014	ND C	0.006-0.012	ND C
BASE NEUTRAL/ACID EXTRACTABLES						
Date Extracted:		8/29/89		8/28/89		8/29/89
Date Analyzed:		9/12/89		9/8/89		9/12/89
bis(2-ethylhexyl)phthalate	0.44	0.76	0.46	ND	0.40	2.30
Other BNAs	0.44-2.10	ND	0.46-2.20	ND	0.40-2.00	ND
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
C10-C24 Aliphatics						
METALS						
Date Prepared:		9/6-8/89		9/6-22/89		9/6-8/89
Date Analyzed:		9/14-10/10/89		9/14-10/10/89		9/14&10/4/89
Cadmium	0.0090	2.1	0.0090	2.7	0.0078	1.4
Chromium, Total	2.8	28	2.7	25	2.2	26
Iron	3.9	30,000	3.8	28,000 M	3.2	28,000
Lead	0.047	21 A,B	0.058	22 A	0.041	38 B
Nickel	1.1	20	1.1	18	0.91	21
Zinc	5.8	110	5.7	120	4.7	140

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-6-2		SB5-7-1		SB5-7-2	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG29		VBAUG29		VBAUG29	
(BNA)	15MB05		-		-	
(PHC)	-		15MB11		15MB11	
(Metals)	1&2		-		-	
Assoc. VOC Hold. Blank						
ANALYTE	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**
VOLATILE ORGANICS						
Date Analyzed:		8/29/89		8/29/89		8/29/89
Methylene Chloride	0.006	ND	0.069	0.058 J	0.033	ND
Acetone	0.013	0.053 C	0.14	0.34 C	0.067	0.11 C
Total Xylenes	0.006	ND	0.069	0.94	0.033	0.087
Benzene	0.006	ND	0.069	ND	0.033	0.041
Ethylbenzene	0.006	ND	0.069	0.55	0.033	0.093
Other Volatiles	0.006-0.013	ND C	0.069-0.14	ND C	0.033-0.067	ND C
BASE NEUTRAL/ACID EXTRACTABLES			NA	NA	NA	NA
Date Extracted:		8/29/89				
Date Analyzed:		9/14/89				
bis(2-ethylhexyl)phthalate	0.41	0.26 J				
Other BNAs	0.41-2.00	ND				
PETROLEUM HYDROCARBONS	NA	NA				
Date Extracted:				9/8/89		9/8/89
Date Analyzed:				9/13/89		9/13/89
C10-C24 Aliphatics			0.60	200.00 S	0.59	36.00 S
METALS			NA	NA	NA	NA
Date Prepared:		9/6-8/89				
Date Analyzed:		9/14&10/4/89				
Cadmium	0.0080	2.0				
Chromium, Total	2.4	26				
Iron	3.4	31,000				
Lead	0.042	15 B				
Nickel	0.98	21				
Zinc	5.1	88				

TABLE A-58: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-8-1		SB5-8-2		SB5-9-1	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG25		VBAUG25		VBAUG25	
(BNA)	-		-		-	
(PHC)	15MB10		15MB10		15MB10	
(Metals)	-		-		-	
Assoc. VOC Hold. Blank	HB76		HB76		HB76	
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/25/89		8/25/89		8/25/89
Methylene Chloride	0.033	ND HB	0.035	ND HB	0.033	ND HB
Acetone	0.067	ND C	0.069	ND C	0.067	ND C
Total Xylenes	0.033	0.038 C	0.035	ND C	0.033	ND C
Benzene	0.033	ND	0.035	ND	0.033	ND
Ethylbenzene	0.033	ND	0.035	ND	0.033	ND
Other Volatiles	0.033-0.067	ND C	0.035-0.069	ND C	0.033-0.067	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
PETROLEUM HYDROCARBONS						
Date Extracted:		9/7/89		9/7/89		9/7/89
Date Analyzed:		9/12/89		9/12/89		9/12/89
C10-C24 Aliphatics	0.59	110.00 S	0.61	ND	0.60	ND
METALS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						

TABLE A-5S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	SB5-9-2		SB5-10-1		SB5-10-2	
Site No.	5		5		5	
Matrix	Soil		Soil		Soil	
Date Sampled	8/16/89		8/16/89		8/16/89	
Assoc. Field Blank	FB6		FB6		FB6	
Assoc. Trip Blank	TB#02		TB#02		TB#02	
Assoc. Equip. Wash	EW6		EW6		EW6	
Assoc. Method Blank:						
(VOC)	VBAUG25		VBAUG28		VBAUG28	
(BNA)	-		-		-	
(PHC)	15MB10		15MB10		15MB10	
(Metals)	-		-		-	
Assoc. VOC Hold. Blank	HB76					
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		8/25/89		8/28/89		8/28/89
Methylene Chloride	0.034	ND HB	0.034	ND	0.033	ND
Acetone	0.068	ND C	0.068	0.12 C	0.067	0.18 C
Total Xylenes	0.034	ND C	0.034	3.40 E	0.033	1.50 E
Benzene	0.034	ND	0.034	0.22	0.033	0.069
Ethylbenzene	0.034	ND	0.034	0.86	0.033	0.79
Other Volatiles	0.034-0.068	ND C	0.034-0.068	ND C	0.033-0.067	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
PETROLEUM HYDROCARBONS						
Date Extracted:		9/7/89		9/7/89		9/7/89
Date Analyzed:		9/12/89		9/12/89		9/12/89
C10-C24 Aliphatics	0.59	ND	0.60	21.00 S	0.60	15.00 S
METALS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						

TABLE A-58: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 SOIL SAMPLES

Sample Station	D3
	SB5-10-2 Repl
Site No.	5
Matrix	Soil
Date Sampled	8/16/89
Assoc. Field Blank	FB6
Assoc. Trip Blank	TB#02
Assoc. Equip. Wash	EW6
Assoc. Method Blank:	
(VOC)	VBAUG28
(BNA)	-
(PHC)	15MB10
(Metals)	-
Assoc. VOC Hold. Blank	

ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS		
Date Analyzed:		8/28/89
Methylene Chloride	0.035	ND M
Acetone	0.069	ND M,C
Total Xylenes	0.035	0.27 M
Benzene	0.035	ND M
Ethylbenzene	0.035	0.11 M
Other Volatiles	0.035-0.069	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA
Date Extracted:		
Date Analyzed:		
bis(2-ethylhexyl)phthalate		
Other BNAs		
PETROLEUM HYDROCARBONS		
Date Extracted:		9/7/89
Date Analyzed:		9/12/89
C10-C24 Aliphatics	0.62	190.00 S,M
METALS	NA	NA
Date Prepared:		
Date Analyzed:		
Cadmium		
Chromium, Total		
Iron		
Lead		
Nickel		
Zinc		

TABLE A-5W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 5 GROUND WATER SAMPLES

Sample Station	MW5-1		R1 MW5-1 Repl		MW5-2	
Site No.	5		5		5	
Matrix	Water		Water		Water	
Date Sampled	12/21/88		12/21/88		12/21/88	
Assoc. Field Blank	FB-4		FB-4		FB-4	
Assoc. Trip Blank	TB-4		TB-4		TB-4	
Assoc. Equip. Wash	EW-4		EW-4		EW-4	
Assoc. Method Blank:						
(VOC)	VBDEC28		-		VBDEC27	
(BNA)	MB009		-		-	
(PHC)	-		-		MB008	
(Metals)	#1,#2		#1,#2		-	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS			NA	NA		
Date Analyzed:		12/28/88				12/27/88
Trichloroethene	5	6.2			5	ND
Other Volatiles	5-100	ND C			5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES			NA	NA	NA	NA
Date Extracted:		12/29/88				
Date Analyzed:		1/4/89				
bis(2-ethylhexyl)phthalate	10	98 B				
Other BNAs	10-50	ND				
PETROLEUM HYDROCARBONS	NA	NA	NA	NA		
Date Extracted:						12/28/88
Date Analyzed:						1/6/89
C10-C24 Aliphatics					50.00	ND
METALS AND INORGANICS					NA	NA
Date Prepared:		1/4-13/89		1/4-13/89		
Date Analyzed:		1/5-15/89		1/5-15/89		
Cadmium	0.3	0.51	NA	NA		
Zinc	4.1	8	NA	NA		
Iron	9.6	ND	NA	NA		
Other Metals	1.1-26	ND	NA	NA		
Sulfate	2,000	42,000	2,000	42,000		

TABLE A-7S: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 7 SOIL SAMPLES

Sample Station	SB7-1-1		SB7-1-2		D4 SB7-1-2 Repl		SB7-1-3	
Site No.	7		7		7		7	
Matrix	Soil		Soil		Soil		Soil	
Date Sampled	8/17/89		8/17/89		8/17/89		8/17/89	
Assoc. Field Blank								
Assoc. Trip Blank	TB#02		TB#02					
Assoc. Equip. Wash	EW7		EW7		EW7		EW7	
Assoc. Method Blank:								
(PHC)	15MB11		15MB11		15MB11		15MB11	
(Metals)	1&2		1&2		1&2		1&2	
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
PETROLEUM HYDROCARBONS								
Date Extracted:		9/8/89		9/8/89		9/8/89		9/8/89
Date Analyzed:		9/13/89		9/13/89		9/13/89		9/13/89
C10-C24 Aliphatics	0.52	26.00 S	0.49	72.00 S	0.50	140.00 S,M	0.47	11.00 S
METALS								
Date Prepared:		9/6/89		9/6/89		9/6/89		9/6/89
Date Analyzed:		9/14/89		9/15/89		9/14/89		9/14/89
Lead	0.036	5.6 B	0.035	4.7 B	0.036	4.9 B	0.035	2.6 B
Other Metals	NA	NA	NA	NA	NA	NA	NA	NA

TABLE A-7W: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, SITE 7 GROUND WATER SAMPLES

Sample Station	MW7-1-1		MW7-2-1		MW7-3-1		D-7 MW7-3-1 Repl		MW7-4-1	
Site No.	7		7		7		7		7	
Matrix	Water		Water		Water		Water		Water	
Date Sampled	8/28/89		8/28/89		8/28/89		8/28/89		8/28/89	
Assoc. Field Blank	FB8		FB8		FB8		FB8		FB8	
Assoc. Trip Blank	"Trip Blank"		"Trip Blank"		"Trip Blank"		"Trip Blank"		"Trip Blank"	
Assoc. Equip. Wash	EW9		EW9		EW9		EW9		EW9	
Assoc. Method Blank:										
(VOC)	VBSEP7		VBSEP7		VBSEP7		VBSEP7		VBSEP7	
(BNA)	15MB07		15MB07		15MB07		15MB07		15MB07	
(Metals)	3&4		3&4		3&4		3&4		3&4	
Assoc. VOC Hold. Blank										
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS										
Date Analyzed:		9/7/89 HT		9/7/89 HT		9/7/89 HT		9/7/89 HT		9/7/89 HT
Methylene Chloride	5	ND	5	4 J	5	3 J	5	ND	5	5
Other Volatiles	5-10	ND C	5-10	ND C	5-10	ND C	5-10	ND C	5-10	ND C
BASE NEUTRAL/ACID EXTRACTABLES	10-50	ND S	10-50	ND S	10-50	ND S	10-50	ND S	10-50	ND
Date Extracted:		9/1/89		9/1/89		9/1/89		9/1/89		9/1/89
Date Analyzed:		10/5/89		10/5/89		10/5/89		10/5/89		10/5/89
METALS										
Date Prepared:		9/19/89		9/19/89		9/19/89		9/19/89		9/19/89
Date Analyzed:		9/30/89		10/6/89		9/29/89		9/29/89		9/29/89
Lead	1.1	14 A	1.1	1.6	1.1	1.8	1.1	7.0	1.1	2.0
Other Metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE A-BGS: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, BACKGROUND SOIL SAMPLES

Sample Station	SBBG1-1	SBBG1-2	SBBG2-1
Site No.	Background	Background	Background
Matrix	Soil	Soil	Soil
Date Sampled	12/14/88	12/14/88	12/14/88
Assoc. Field Blank	FB3-1	FB3-1	FB3-1
Assoc. Trip Blank			
Assoc. Equip. Wash	EW3-1	EW3-1	EW3-1
Assoc. Method Blank:			
(VOC)	VBDEC21	VBDEC21	VBDEC21
(BNA)	-	-	-
(PCB)	MB003	MB003	MB003
(PHC)	MB003	MB003	MB003
(Metals)	-	-	-
Assoc. VOC Hold. Blank			

ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS						
Date Analyzed:		12/21/88		12/21/88		12/21/88
Methylene Chloride	0.006	0.022 C	0.006	0.009 C	0.006	ND C
Other Volatiles	0.006-0.12	ND C	0.006-0.12	ND C	0.006-0.11	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
POLYCHLORINATED BIPHENYLS	0.16	ND	0.17	ND	0.17	ND
Date Extracted:		12/22/88		12/22/88		12/22/88
Date Analyzed:		1/4/89		1/4/89		1/4/89
PETROLEUM HYDROCARBONS						
Date Extracted:		12/22/88		12/22/88		12/22/88
Date Analyzed:		1/7/89		1/7/89		1/8/89
C10-C24 Aliphatics	1.8	ND	2.0	ND	1.9	ND
METALS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						

TABLE A-BGS: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, BACKGROUND SOIL SAMPLES

	SBBG2-1R Repl		SBBG2-2		SBBG-1	
Sample Station	SBBG2-1R Repl		SBBG2-2		SBBG-1	
Site No.	Background		Background		Background	
Matrix	Soil		Soil		Soil	
Date Sampled	12/14/88		12/14/88		8/22/89	
Assoc. Field Blank	FB3-1		FB3-1		FB7	
Assoc. Trip Blank						
Assoc. Equip. Wash	EW3-1		EW3-1		EW8	
Assoc. Method Blank:						
(VOC)	VBDEC21		VBDEC21		-	
(BNA)	-		-		15MB05	
(PCB)	MB003		MB003		-	
(PHC)	MB003		MB003		-	
(Metals)	-		-		#1 & #2	
Assoc. VOC Hold. Blank						
ANALYTE	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**	**Reporting Limit (mg/kg)**	**Sample Result (mg/kg)**
VOLATILE ORGANICS					NA	NA
Date Analyzed:		12/21/88		12/21/88		
Methylene Chloride	0.006	0.008 C	0.006	0.008 C		
Other Volatiles	0.006-0.13	ND C	0.006-0.12	ND C		
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA		
Date Extracted:						8/29/89
Date Analyzed:						9/14/89
bis(2-ethylhexyl)phthalate					0.37	0.43
Other BNAs					0.37-1.80	ND
POLYCHLORINATED BIPHENYLS	0.16	ND	0.17	ND	NA	NA
Date Extracted:		12/22/88		12/22/88		
Date Analyzed:		1/5/89		1/5/89		
PETROLEUM HYDROCARBONS					NA	NA
Date Extracted:		12/22/88		12/22/88		
Date Analyzed:		1/8/89		1/8/89		
C10-C24 Aliphatics	1.9	ND	1.9	ND		
METALS	NA	NA	NA	NA		
Date Prepered:						9/6-8/89
Date Analyzed:						9/14-10/4/89
Cadmium					0.0069	0.19
Chromium, Total					2.1	21
Iron					3.0	24,000
Lead					0.036	11 B
Nickel					0.85	16
Zinc					4.4	54

TABLE A-BGS: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, BACKGROUND SOIL SAMPLES

Sample Station		SBBG-2		D5 SBBG-2 Repl
Site No.		Background		Background
Matrix		Soil		Soil
Date Sampled		8/22/89		8/22/89
Assoc. Field Blank		FB7		FB7
Assoc. Trip Blank				
Assoc. Equip. Wash		EW8		EW8
Assoc. Method Blank:				
(VOC)		-		-
(BNA)		15MB05		15MB05
(PCB)		-		-
(PHC)		-		-
(Metals)		#1 & #2		#1 & #2
Assoc. VOC Hold. Blank				
ANALYTE	Reporting Limit (mg/kg)	Sample Result (mg/kg)	Reporting Limit (mg/kg)	Sample Result (mg/kg)
VOLATILE ORGANICS	NA	NA	NA	NA
Date Analyzed:				
Methylene Chloride				
Other Volatiles				
BASE NEUTRAL/ACID EXTRACTABLES				
Date Extracted:		8/29/89		8/29/89
Date Analyzed:		9/14/89		9/14/89
bis(2-ethylhexyl)phthalate	0.42	ND	0.41	16 E
Other BNAs	0.42-2.10	ND	0.41-2.00	ND
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA
Date Extracted:				
Date Analyzed:				
PETROLEUM HYDROCARBONS	NA	NA	NA	NA
Date Extracted:				
Date Analyzed:				
C10-C24 Aliphatics				
METALS				
Date Prepared:		9/6-8/89		9/6-8/89
Date Analyzed:		9/14-10/4/89		9/14-10/4/89
Cadmium	0.0082	0.20	0.0083	0.21
Chromium, Total	2.4	24	2.4	26
Iron	3.4	25,000	3.3	29,000
Lead	0.043	14 B	0.043	19 B
Nickel	0.97	17	0.96	21
Zinc	5.1	54	5.0	59

TABLE A-BGW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, BACKGROUND GROUND WATER SAMPLES

Sample Station	MWBG-1	D-6 MWBG-1 Repl
Site No.	Background	Background
Matrix	Water	Water
Date Sampled	8/28/89	8/28/89
Assoc. Field Blank	FB8	FB8
Assoc. Trip Blank	"Trip Blank"	"Trip Blank"
Assoc. Equip. Wash	EW9	EW9
Assoc. Method Blank:		
(VOC)	VBSEP7	VBSEP7
(BNA)	15MB07	15MB07
(PCB)	15MB08	15MB08
(PHC)	15MB12	15MB12
(Metals/Inorganics)	1&2,5&6	1&2,5&6
Assoc. VOC Hold. Blank		

ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS	5-10	ND C	5-10	ND C
Date Analyzed:		9/7/89 HT		9/7/89 HT
BASE NEUTRAL/ACID EXTRACTABLES	10-50	ND	10-50	ND
Date Extracted:		9/1/89		9/1/89
Date Analyzed:		9/15/89		10/5/89
POLYCHLORINATED BIPHENYLS	0.7-2.5	ND	0.7-2.5	ND
Date Extracted:		9/1/89		9/1/89
Date Analyzed:		9/19/89		9/19/89
PETROLEUM HYDROCARBONS				
Date Extracted:		9/8/89		9/8/89
Date Analyzed:		9/16/89		9/16/89
C10-C24 Aliphatics	13.0	ND	13.0	ND
METALS AND INORGANICS				
Date Prepared:		9/8-28/89		9/8-28/89
Date Analyzed:		9/15-10/4/89		9/14-10/4/89
Cadmium	0.080	0.86	0.080	0.57
Chromium, Total	5.9	ND	5.9	8.0
Iron	12	830	12	670
Lead	1.1	2.2	1.1	2.0
Nickel	14	ND	14	ND
Zinc	5.9	30	5.9	26
Sulfate as SO4	NR	13,000	NR	12,000

TABLE A-FB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, FIELD BLANK SAMPLES

Sample Identification	F1-1		FB2-1		FB3-1	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	12/9/88		12/13/88		12/13/88	
Assoc. Trip Blank						
Assoc. Method Blank:						
(VOC)	VBDEC14		VBDEC22		VBDEC22	
(BNA)	-		-		-	
(PCB)	MB002		-		-	
(PHC)	MB001		-		MB005	
(Metals/Inorganics)	-		-		-	
Assoc. VOC Hold. Blank	HB30					
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		12/14/88		12/22/88 HT		12/22/88 HT
Methylene Chloride	5	11 HB	5	ND	5	ND
Acetone	100	ND C	100	ND C	100	ND C
Other Volatiles	5-100	ND C	5-100	ND C	5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
POLYCHLORINATED BIPHENYLS	0.5	ND	NA	NA	NA	NA
Date Extracted:		12/19/88				
Date Analyzed:		12/31/88				
PETROLEUM HYDROCARBONS			NA	NA		
Date Extracted:		12/21/88				12/16/88
Date Analyzed:		1/5/89				1/7/89
C10-C24 Aliphatics	50.00	ND			50.00	ND
METALS AND INORGANICS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						
Sulfate as SO4						

TABLE A-FB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, FIELD BLANK SAMPLES

Sample Identification	FB4	FBE-1	FBE-2
Matrix	Aqueous	Aqueous	Aqueous
Date Collected	12/21/88	1/19/89	1/19/89
Assoc. Trip Blank			
Assoc. Method Blank:			
(VOC)	VBDEC22	-	VBJAN30
(BNA)	MB009AQ	-	-
(PCB)	MB007	MB010	-
(PHC)	MB008	-	-
(Metals/Inorganics)	#1,#2	-	-
Assoc. VOC Hold. Blank			

ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS			NA	NA		
Date Analyzed:		12/22/88				1/30/89 HT
Methylene Chloride	5	ND			5	ND
Acetone	100	ND C			100	ND C
Other Volatiles	5-100	ND C			5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES			NA	NA	NA	NA
Date Extracted:		12/29/88				
Date Analyzed:		1/4/89				
bis(2-ethylhexyl)phthalate	10	87 B				
Other BNAs	10-50	ND				
POLYCHLORINATED BIPHENYLS	0.5	ND S	0.46	ND	NA	NA
Date Extracted:		12/27/88		1/24/89		
Date Analyzed:		1/5/89		2/2/89		
PETROLEUM HYDROCARBONS			NA	NA	NA	NA
Date Extracted:		12/28/88				
Date Analyzed:		1/6/89				
C10-C24 Aliphatics	50	ND				
METALS AND INORGANICS			NA	NA	NA	NA
Date Prepared:		1/4-13/89				
Date Analyzed:		1/5-15/89				
Cadmium	0.3	ND				
Chromium, Total	12	ND				
Iron	9.6	ND				
Lead	1.1	ND				
Nickel	26	ND				
Zinc	4.1	ND				
Sulfate as SO4	200	ND				

TABLE A-FB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, FIELD BLANK SAMPLES

Sample Identification	FBE-3		FB5		FB6	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	1/24/89		8/16/89		8/16/89	
Assoc. Trip Blank			TB#01		TB#02	
Assoc. Method Blank:						
(VOC)	VBJAN29		VBAUG23		VBAUG29	
(BNA)	-		-		15MB02	
(PCB)	-		-		-	
(PHC)	-		15MB-01		15MB06	
(Metals/Inorganics)	-		1,2,5,6		1,2,5,6	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		1/29/89		8/23/89		8/29/89 HT
Methylene Chloride	5	ND	5	15	5	30
Acetone	100	ND	10	ND	10	180 C
Other Volatiles	5-100	ND	5-10	ND	5-10	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA		
Date Extracted:						8/23/89
Date Analyzed:						9/8/89
bis(2-ethylhexyl)phthalate					10	99
Other BNAs					10-50	ND
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
PETROLEUM HYDROCARBONS	NA	NA				
Date Extracted:				8/22/89		8/31/89
Date Analyzed:				9/6/89		9/11/89
C10-C24 Aliphatics			13.0	ND	13.0	ND
METALS AND INORGANICS	NA	NA				
Date Prepared:				9/8-28/89		9/8-28/89
Date Analyzed:				9/15-10/4/89		9/15-10/4/89
Cadmium			0.080	ND	0.080	0.34
Chromium, Total			5.9	ND	5.9	7.0
Iron			NA	NA	12	ND
Lead			1.1	1.6 A	1.1	ND
Nickel			14	ND	14	ND
Zinc			5.9	ND	5.9	ND
Sulfate as SO4			NA	NA	NA	NA

TABLE A-FB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, FIELD BLANK SAMPLES

Sample Identification	FB7		FB8	
Matrix	Aqueous		Aqueous	
Date Collected	8/22/89		8/28/89	
Assoc. Trip Blank			"Tripblank"	
Assoc. Method Blank:				
(VOC)	-		VBSEP7	
(BNA)	15MB04		15MB07	
(PCB)	-		15MB08	
(PHC)	-		15MB12	
(Metals/Inorganics)	1,2		1,2,5,6	
Assoc. VOC Hold. Blank				
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS	NA	NA		
Date Analyzed:				9/7/89 HT
Methylene Chloride			5	ND
Acetone			10	ND C
Other Volatiles			5-10	ND C
BASE NEUTRAL/ACID EXTRACTABLES				
Date Extracted:		8/29/89		9/1/89
Date Analyzed:		9/14/89		10/5/89
bis(2-ethylhexyl)phthalate	10	ND	10	ND
Other BNAs	10-50	ND	10-50	ND
POLYCHLORINATED BIPHENYLS	NA	NA	0.93-3.3	ND
Date Extracted:				9/1/89
Date Analyzed:				9/19/89
PETROLEUM HYDROCARBONS	NA	NA		
Date Extracted:				9/8/89
Date Analyzed:				9/15/89
C10-C24 Aliphatics			13.0	ND
METALS AND INORGANICS				
Date Prepared:		9/8-28/89		9/8-28/89
Date Analyzed:		9/15&10/4/89		9/15-10/4/89
Cadmium	0.080	ND	0.080	ND
Chromium, Total	5.9	ND	5.9	ND
Iron	NA	NA	12	ND
Lead	NA	NA	1.1	4.8
Nickel	14	ND	14	ND
Zinc	5.9	ND	5.9	ND
Sulfate as SO4	NA	NA	NR	2,000

TABLE A-EW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, EQUIPMENT WASH SAMPLES

Sample Identification	EW1-1		EW2-1		EW3-1	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	12/9/88		12/13/88		12/13/88	
Assoc. Trip Blank	TB-1		TB-3		TB-3	
Assoc. Method Blank:						
(VOC)	VBDEC14		VBDEC22		VBDEC22	
(BNA)	-		-		-	
(PCB)	MB002		-		-	
(PHC)	MB001		-		MB005	
(Metals/Inorganics)	-		-		-	
Assoc. VOC Hold. Blank	HB28					
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		12/14/88		12/22/88 HT		12/22/88 HT
Methylene Chloride	5	6.8 HB	5	ND	5	ND
Acetone	100	ND C	100	ND C	100	ND C
Other Volatiles	5-100	ND C	5-100	ND C	5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
POLYCHLORINATED BIPHENYLS	0.5	ND	NA	NA	NA	NA
Date Extracted:		12/19/88				
Date Analyzed:		12/31/88				
PETROLEUM HYDROCARBONS			NA	NA		
Date Extracted:		12/21/88				12/16/88
Date Analyzed:		1/5/89				1/6/89
C10-C24 Aliphatics	50.00	ND			50.00	245 B
METALS AND INORGANICS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						
Sulfate as SO4						

TABLE A-EW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, EQUIPMENT WASH SAMPLES

Sample Identification	EW-4		EWE-1		EWE-2	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	12/21/88		1/19/89		1/19/89	
Assoc. Trip Blank	TB-4		TBE-1		TBE-1	
Assoc. Method Blank:						
(VOC)	VBDEC27A		-		VBFEB2	
(BNA)	MB009AQ		-		-	
(PCB)	MB007		MB010		-	
(PHC)	MB008		-		-	
(Metals/Inorganics)	MB#1,MB#2		-		-	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS			NA	NA		
Date Analyzed:		12/27/88				2/2/89 HT
Methylene Chloride	5	5 C			5	ND
Acetone	100	ND C			100	ND
Other Volatiles	5-100	ND C			5-100	ND
BASE NEUTRAL/ACID EXTRACTABLES			NA	NA	NA	NA
Date Extracted:		12/29/88				
Date Analyzed:		1/4/89				
bis(2-ethylhexyl)phthalate	10	13 B				
Other BNAs	10-50	ND				
POLYCHLORINATED BIPHENYLS	0.5	ND S	4.6	ND	NA	NA
Date Extracted:		12/27/88		1/24/89		
Date Analyzed:		1/5/89		2/1/89		
PETROLEUM HYDROCARBONS			NA	NA	NA	NA
Date Extracted:		12/28/88				
Date Analyzed:		1/6/89				
C10-C24 Aliphatics	50.00	ND				
METALS AND INORGANICS			NA	NA	NA	NA
Date Prepared:		1/4-13/89				
Date Analyzed:		1/5-15/89				
Cadmium	0.3	ND				
Chromium, Total	12	ND				
Iron	9.6	ND				
Lead	1.1	ND				
Nickel	26	ND				
Zinc	4.1	ND				
Sulfate as SO4	200	ND				

TABLE A-EW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, EQUIPMENT WASH SAMPLES

Sample Identification	EWE-3		EWE-4		EWE-5	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	1/24/89		1/25/89		1/26/89	
Assoc. Trip Blank	TBE-2				TBE-3	
Assoc. Method Blank:						
(VOC)	VBJAN31A		VBFEB2		VBJAN31A	
(BNA)	-		-		-	
(PCB)	-		-		-	
(PHC)	-		-		-	
(Metals/Inorganics)	-		-		-	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		1/31/89		2/2/89 HT		1/31/89
Methylene Chloride	5	ND	5	ND	5	ND
Acetone	100	ND	100	ND	100	ND
Other Volatiles	5-100	ND C	5-100	ND	5-100	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
bis(2-ethylhexyl)phthalate						
Other BNAs						
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
PETROLEUM HYDROCARBONS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
C10-C24 Aliphatics						
METALS AND INORGANICS	NA	NA	NA	NA	NA	NA
Date Prepared:						
Date Analyzed:						
Cadmium						
Chromium, Total						
Iron						
Lead						
Nickel						
Zinc						
Sulfate as SO4						

TABLE A-EW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, EQUIPMENT WASH SAMPLES

Sample Identification	EWE-6		EW-5		EW-6	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	1/27/89		8/15/89		8/16/89	
Assoc. Trip Blank	TBE-4		TB#01		TB#02	
Assoc. Method Blank:						
(VOC)	VBJAN31A		VBAUG23		VBAUG28	
(BNA)	-		-		15MB02	
(PCB)	-		-		-	
(PHC)	-		15MB-01		15MB06	
(Metals/Inorganics)	-		1,2,5,6		1,2,5,6	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS						
Date Analyzed:		1/31/89		8/23/89 HT		8/28/89 HT
Methylene Chloride	5	ND	5	12 S	5	ND
Acetone	100	ND	10	ND	10	ND C
Other Volatiles	5-100	ND C	5-10	ND US	5-10	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA	NA	NA		
Date Extracted:						8/23/89
Date Analyzed:						9/8/89
bis(2-ethylhexyl)phthalate					10	16
Other BNAs					10-50	ND
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA	NA	NA
Date Extracted:						
Date Analyzed:						
PETROLEUM HYDROCARBONS	NA	NA				
Date Extracted:				8/22/89		8/31/89
Date Analyzed:				9/6/89		9/11/89
C10-C24 Aliphatics			13.0	ND	27.0	ND
METALS AND INORGANICS	NA	NA				
Date Prepared:				9/8-28/89		9/8-28/89
Date Analyzed:				9/15-10/4/89		9/15-10/4/89
Cadmium			0.080	0.43	0.080	0.39
Chromium, Total			5.9	ND	5.9	ND
Iron			NA	NA	12	ND
Lead			1.1	ND	1.1	5.3
Nickel			14	ND	14	ND
Zinc			5.9	16	5.9	19
Sulfate as SO4			NA	NA	NA	NA

TABLE A-EW: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, EQUIPMENT WASH SAMPLES

Sample Identification	EW-7		EW-8		EW-9	
Matrix	Aqueous		Aqueous		Aqueous	
Date Collected	8/17/89		8/22/89		8/28/89	
Assoc. Trip Blank					"Tripblank"	
Assoc. Method Blank:						
(VOC)	-		-		VBSEP7	
(BNA)	-		15MB04		15MB07	
(PCB)	-		-		15MB08	
(PHC)	15MB06		-		15MB12	
(Metals/Inorganics)	-		1,2		1,2,5,6	
Assoc. VOC Hold. Blank						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS	NA	NA	NA	NA		
Date Analyzed:						9/7/89 HT
Methylene Chloride					5	17
Acetone					10	90 C
Other Volatiles					5-10	ND C
BASE NEUTRAL/ACID EXTRACTABLES	NA	NA				
Date Extracted:				8/29/89		9/1/89
Date Analyzed:				9/14/89		10/5/89
bis(2-ethylhexyl)phthalate			10	ND	10	ND
Other BNAs			10-50	ND	10-50	ND
POLYCHLORINATED BIPHENYLS	NA	NA	NA	NA	0.7-2.5	ND
Date Extracted:						9/1/89
Date Analyzed:						9/19/89
PETROLEUM HYDROCARBONS			NA	NA		
Date Extracted:		8/31/89				9/8/89
Date Analyzed:		9/11/89				9/15/89
C10-C24 Aliphatics	27.0	ND M			13.0	ND
METALS AND INORGANICS	NA	NA				
Date Prepared:				9/8-28/89		9/8-28/89
Date Analyzed:				9/15&10/4/89		9/15-10/4/89
Cadmium			0.080	0.28	0.080	0.39
Chromium, Total			5.9	10	5.9	ND
Iron			NA	NA	12	ND
Lead			NA	NA	1.1	4.3
Nickel			14	ND	14	ND
Zinc			5.9	ND	5.9	8.0
Sulfate as SO4			NA	NA	NR	2,000

TABLE A-TB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, TRIP BLANK SAMPLES

Sample Identification		TB-1		TB-2		TB-3		TB-4		TBE-1
Matrix		Aqueous		Aqueous		Aqueous		Aqueous		Aqueous
Date Collected		12/8/88		12/8/88		12/8/88		12/8/88		1/19/89
Assoc. Method Blank:										
(VOC)		VBDEC14		VBDEC14		VBDEC22		VBDEC22		VBJAN30
Assoc. VOC Hold. Blank		HB29		HB29						
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS										
Date Analyzed:		12/14/88		12/14/88		12/22/88 HT		12/22/88 HT		1/30/89 HT
Methylene Chloride	5	9 HB	5	21 HB	5	ND	5	ND	5	ND
Other Volatiles	5-100	ND C	5-100	ND C	5-100	ND C	5-100	ND C	5-100	ND C

TABLE A-TB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, TRIP BLANK SAMPLES

Sample Identification	TBE-2		TBE-3		TBE-4		TB#01		TB#02	
Matrix	Aqueous		Aqueous		Aqueous		Aqueous		Aqueous	
Date Collected	1/24/89		1/26/89		1/27/89		8/15/89		8/16/89	
Assoc. Method Blank: (VOC)	VBJAN29		VBJAN30		VBJAN29		VBAUG23		VBAUG28	
Assoc. VOC Hold. Blank										
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS										
Date Analyzed:		1/29/89		1/30/89		1/29/89		8/23/89 HT		8/28/89 HT
Methylene Chloride	5	ND	5	ND	5	ND	5	ND	5	ND
Other Volatiles	5-100	ND	5-100	ND C	5-100	ND	5-10	ND	5-10	ND C

TABLE A-TB: CHEMICAL ANALYTICAL RESULTS - ANG PORTLAND SITE INVESTIGATION, TRIP BLANK SAMPLES

Sample Identification		"Tripblank"
Matrix		Aqueous
Date Collected		8/28/89
Assoc. Method Blank:		
(VOC)		VBSEP6
Assoc. VOC Hold. Blank		
ANALYTE	Reporting Limit (ug/L)	Sample Result (ug/L)
VOLATILE ORGANICS		
Date Analyzed:		9/6/89 HT
Methylene Chloride	5	9 B
Other Volatiles	5-10	ND C

APPENDIX B

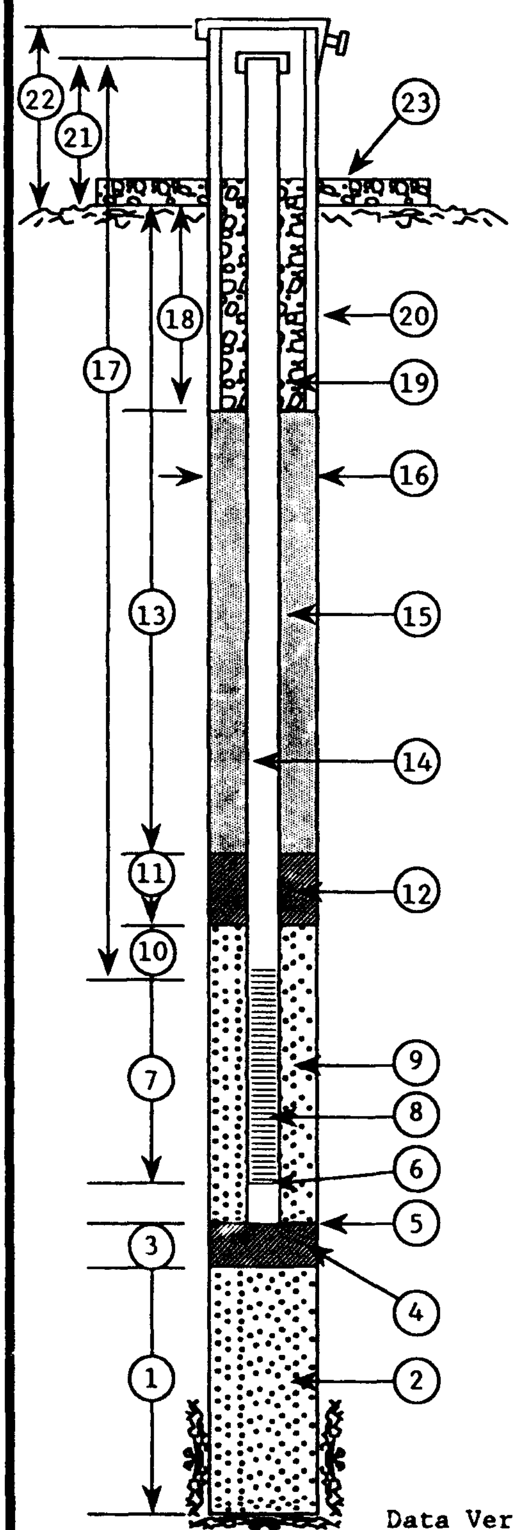
MONITORING WELL INSTALLATION LOGS

AND BOREHOLE LOGS

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 1-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
INSTALLATION TEAM:
Paul Montgomery & Wayne Lindholm

GROUND SURFACE ELEVATION: 15.62
TOP OF WELL CASING ELEVATION: 17.89
START DATE: 12/14/88 TIME: 1100
END DATE: 12/15/88 TIME: 0900



1. DEPTH OF BOREHOLE 15 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 13 FEET.
6. DEPTH TO TOP OF SUMP: 12 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 12 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 7 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 5 FEET.
12. TYPE OF UPPER SEAL: GROUT.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 4 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 16 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 1.7 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 2.3 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 3 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brett R. [signature] Date 31 May 1990
Data Reviewed by [signature] Date 31 May 1990

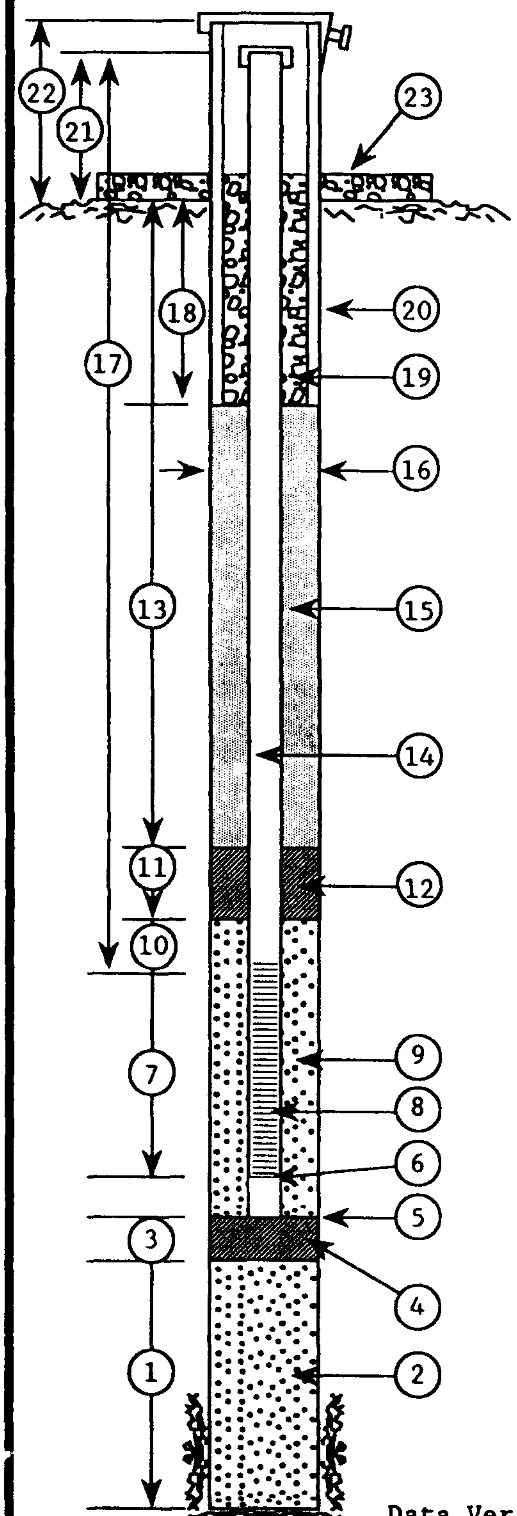
SAIC.

MONITORING WELL INSTALLATION LOG

BOREHOLE/WELL NUMBER: MW 1-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
RUSS DEIKE & HAROLD NISWANDER

GROUND SURFACE ELEVATION: 15.02
TOP OF WELL CASING ELEVATION: 16.32
START DATE: 1/25/89 TIME: 1200
END DATE: 1/26/89 TIME: 1100



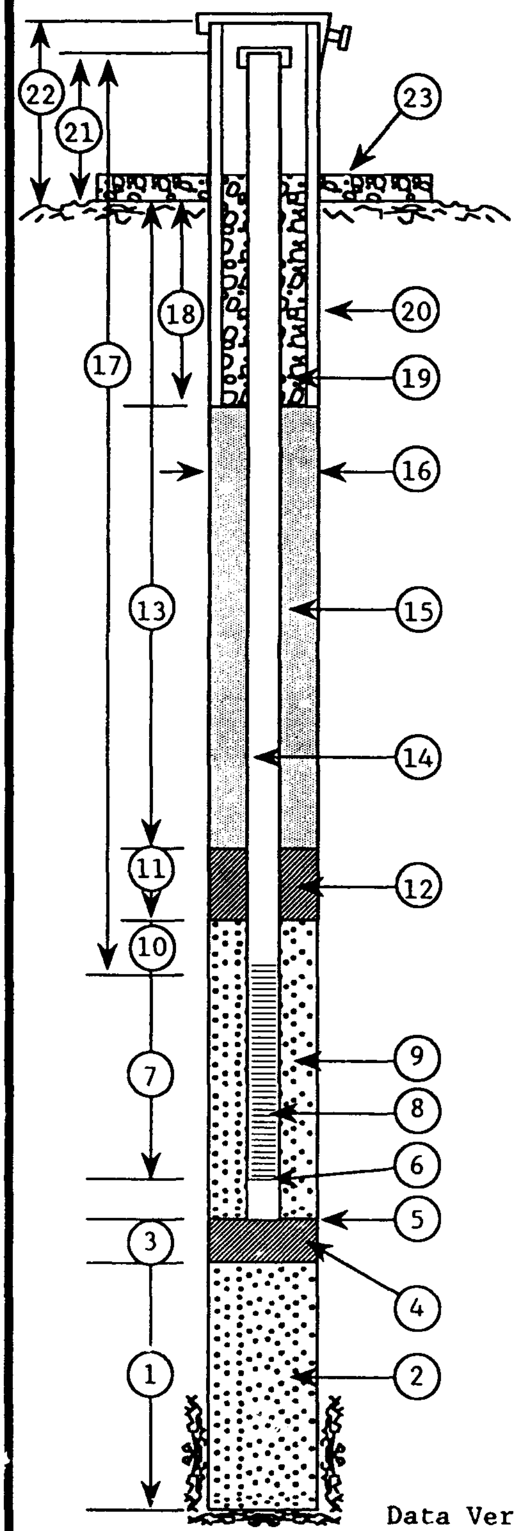
1. DEPTH OF BOREHOLE 15 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 14 FEET.
6. DEPTH TO TOP OF SUMP: 13 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 13 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 8 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 6 FEET.
12. TYPE OF UPPER SEAL: BENTONITE CHIPS.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 2 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: BENTONITE.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 9 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.3 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified *Brett R. Freis* Date *31 May 1990*
Data Reviewed by *[signature]* Date *31 May 1990*

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 2-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
INSTALLATION TEAM:
Paul Montgomery & Wayne Lindholm

GROUND SURFACE ELEVATION: 14.84
TOP OF WELL CASING ELEVATION: 16.45
START DATE: 12/16/88 TIME: 1115
END DATE: 12/16/88 TIME: 1430



1. DEPTH OF BOREHOLE 13.5 FEET.
2. TYPE OF LOWER BACKFILL: Natural.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC Sump.
5. DEPTH TO BOTTOM OF SUMP 11 FEET.
6. DEPTH TO TOP OF SUMP: 10 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 10 FEET.
8. TYPE OF SCREEN MATERIAL: Sch 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 Sand.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 5 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 3 FEET.
12. TYPE OF UPPER SEAL: Bentonite Pellets.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 2 FEET.
14. TYPE OF RISER PIPE MATERIAL: Sch 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: Grout.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 7 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: Cement.
20. TYPE OF WELL COVER: Carbon Steel.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.6 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brett R. [illegible] Date 31 May 1990
Data Reviewed by [illegible] Date 31 May 1990

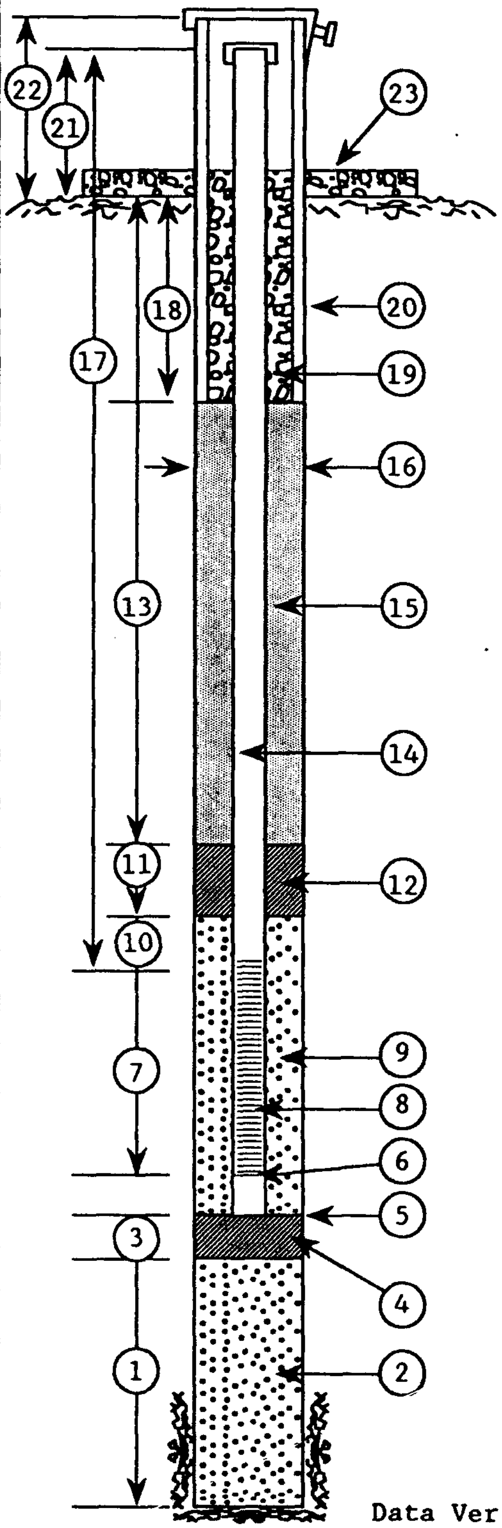
SAIC.

MONITORING WELL INSTALLATION LOG

BOREHOLE/WELL NUMBER: MW 2-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
TERRY ASBERRY & RUSS DEIKE

GROUND SURFACE ELEVATION: 15.25
TOP OF WELL CASING ELEVATION: 16.84
START DATE: 8/23/89 TIME: 0720
END DATE: 8/23/89 TIME: 1030



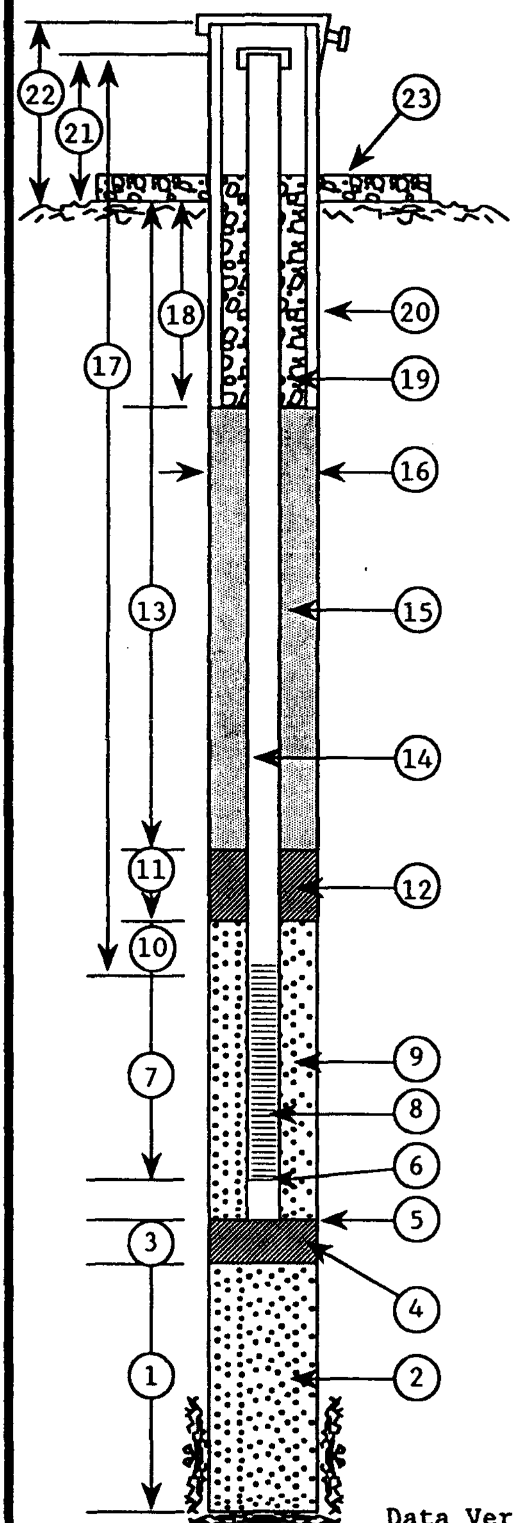
1. DEPTH OF BOREHOLE 16 FEET.
2. TYPE OF LOWER BACKFILL: 10-20 SAND.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 16 FEET.
6. DEPTH TO TOP OF SUMP: 15 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 15 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 10 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 7 FEET.
12. TYPE OF UPPER SEAL: BENTONITE.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 6 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 12 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 3 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.6 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified *Brett R. Freiler* Date *31 May 1990*
Data Reviewed by *[signature]* Date *31 May 90*

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 3-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
INSTALLATION TEAM:
Paul Montgomery & Wayne Lindholm

GROUND SURFACE ELEVATION: 15.95
TOP OF WELL CASING ELEVATION: 18.12
START DATE: 12/15/88 TIME: 1130
END DATE: 12/16/88 TIME: 1000



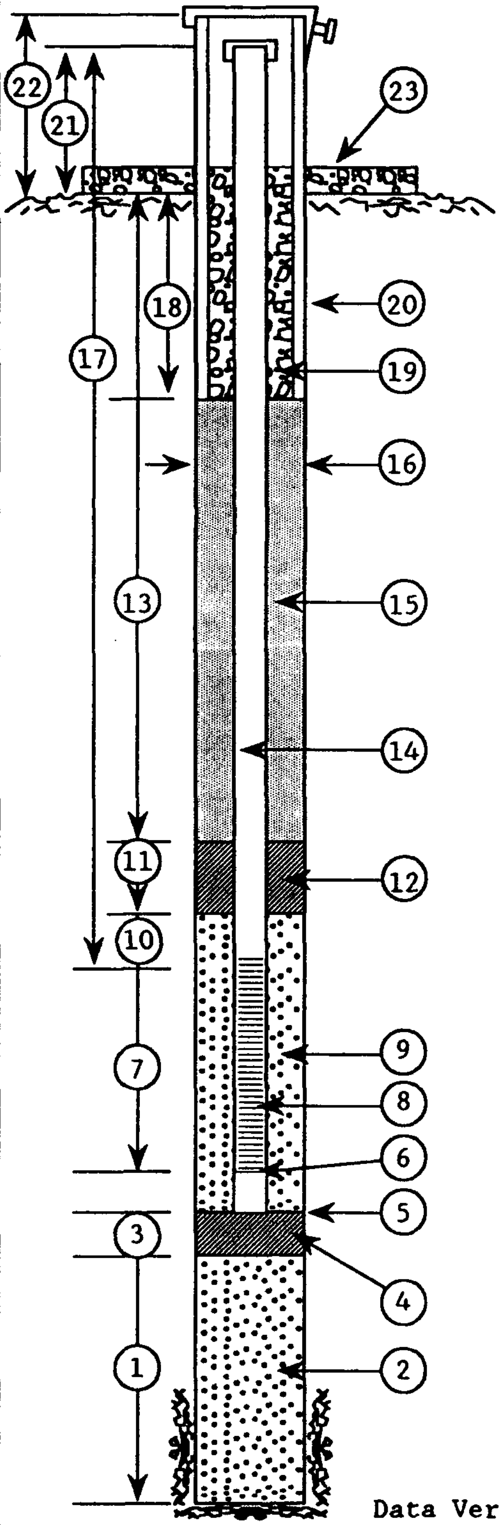
1. DEPTH OF BOREHOLE 15 FEET.
2. TYPE OF LOWER BACKFILL: SAND.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 13 FEET.
6. DEPTH TO TOP OF SUMP: 12 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 12 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 7 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 7 FEET.
12. TYPE OF UPPER SEAL: BENTONITE PELLETS.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 5 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 9 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 6 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 2.17 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 3 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brent R. Freier Date 31 May 1990
Data Reviewed by Daryl Dyck Date 31 May 90

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 5-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
INSTALLATION TEAM:
Paul Montgomery & Wayne Lindholm

GROUND SURFACE ELEVATION: 17.18
TOP OF WELL CASING ELEVATION: 19.23
START DATE: 12/16/88 TIME: 1530
END DATE: 12/17/88 TIME: 1000



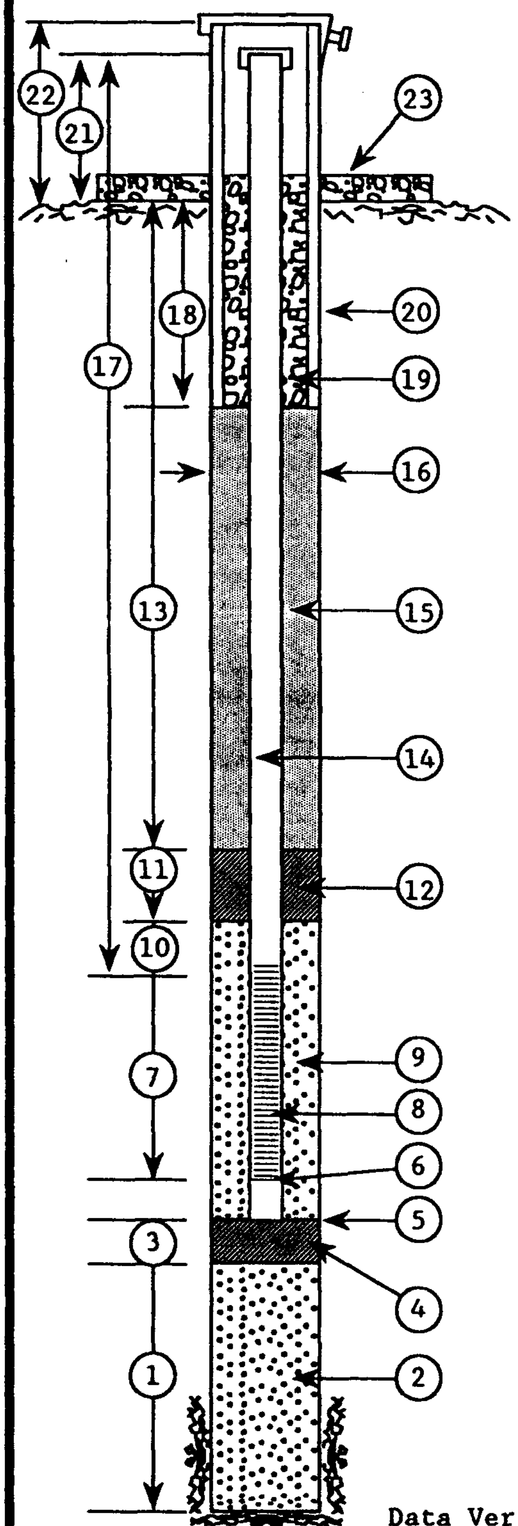
1. DEPTH OF BOREHOLE 15 FEET.
2. TYPE OF LOWER BACKFILL: 10-20 Sand.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC Sump.
5. DEPTH TO BOTTOM OF SUMP 12 FEET.
6. DEPTH TO TOP OF SUMP: 11 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 11 FEET.
8. TYPE OF SCREEN MATERIAL: Sch 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 Sand.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 6 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 4 FEET.
12. TYPE OF UPPER SEAL: Bentonite Pellets.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 3 FEET.
14. TYPE OF RISER PIPE MATERIAL: Sch 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: Bentonite (dry).
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 8 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: Cement.
20. TYPE OF WELL COVER: Carbon Steel.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 2.1 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 3 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified [signature] Date 31 May 1990
Data Reviewed by [signature] Date 31 May 90

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 5-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
INSTALLATION TEAM:
Paul Montgomery & Wayne Lindholm

GROUND SURFACE ELEVATION: 18.21
TOP OF WELL CASING ELEVATION: 20.26
START DATE: 12/17/88 TIME: 1100
END DATE: 12/17/88 TIME: 1600



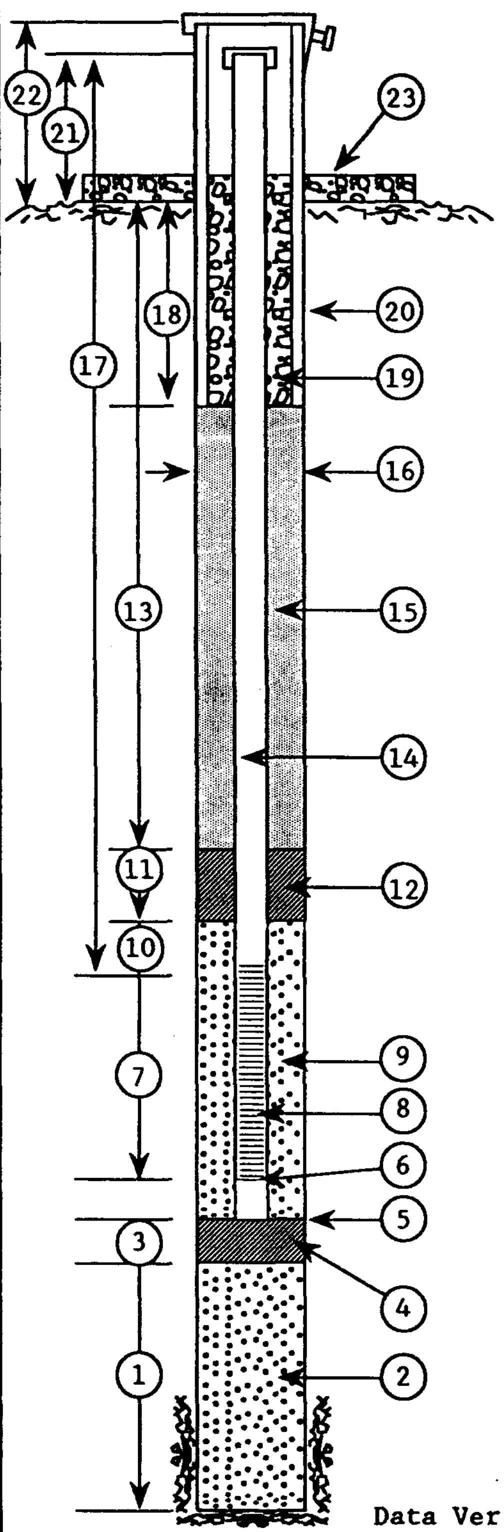
1. DEPTH OF BOREHOLE 12 FEET.
2. TYPE OF LOWER BACKFILL: NONE.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC Sump.
5. DEPTH TO BOTTOM OF SUMP 12 FEET.
6. DEPTH TO TOP OF SUMP: 11 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 11 FEET.
8. TYPE OF SCREEN MATERIAL: Sch 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 Sand.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 6 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 4 FEET.
12. TYPE OF UPPER SEAL: Bentonite Pellets.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 3 FEET.
14. TYPE OF RISER PIPE MATERIAL: Sch 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: Bentonite (dry).
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 8 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: Cement.
20. TYPE OF WELL COVER: Carbon Steel.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 2.1 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 3 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified *Brett R. Freei* Date *31 May 1990*
Data Reviewed by *[signature]* Date *31 May 90*

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 7-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
TERRY ASBERRY & RUSS DEIKE

GROUND SURFACE ELEVATION: 24.97
TOP OF WELL CASING ELEVATION: 26.70
START DATE: 8/23/89 TIME: 1040
END DATE: 8/23/89 TIME: 1425



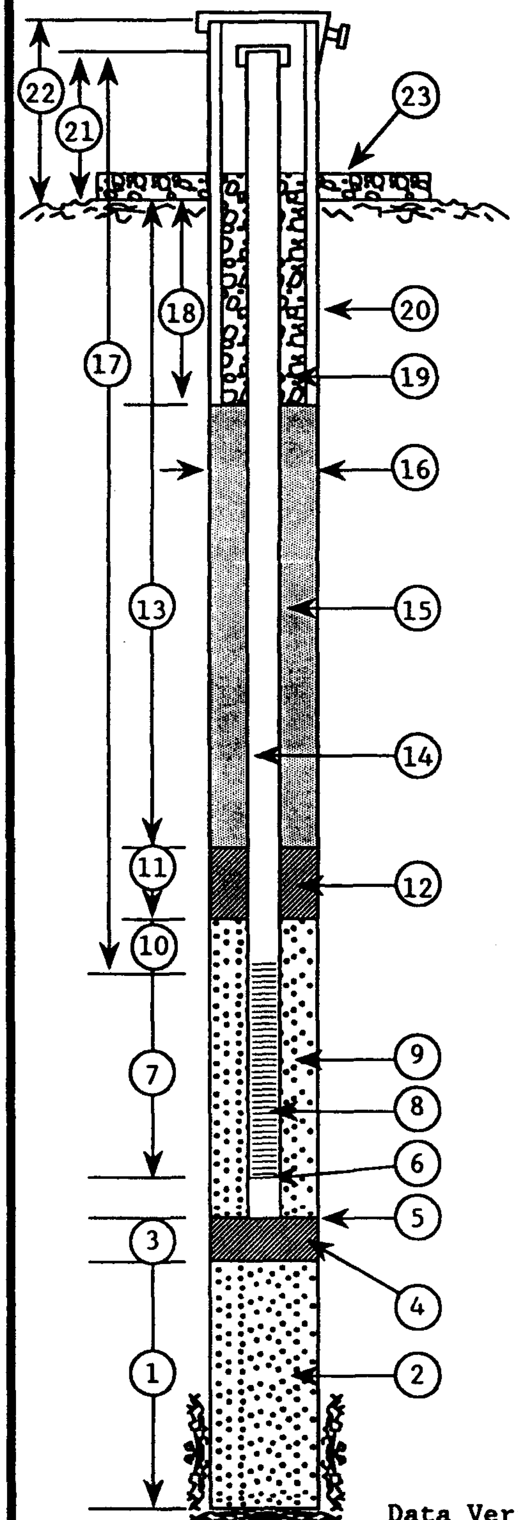
1. DEPTH OF BOREHOLE 25 FEET.
2. TYPE OF LOWER BACKFILL: BENTONITE.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: 25 FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 22 FEET.
6. DEPTH TO TOP OF SUMP: 21 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 21 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INC INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 16 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 15 FEET.
12. TYPE OF UPPER SEAL: BENTONITE.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 13 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 18 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 3 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.7 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brett R. Fresz Date 31 May 1990
Data Reviewed by [illegible] Date 31 May 90

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 7-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
TERRY ASBERRY & RUSS DEIKE

GROUND SURFACE ELEVATION: 19.18
TOP OF WELL CASING ELEVATION: 20.97
START DATE: 8/24/89 TIME: 0750
END DATE: 8/24/89 TIME: 1045



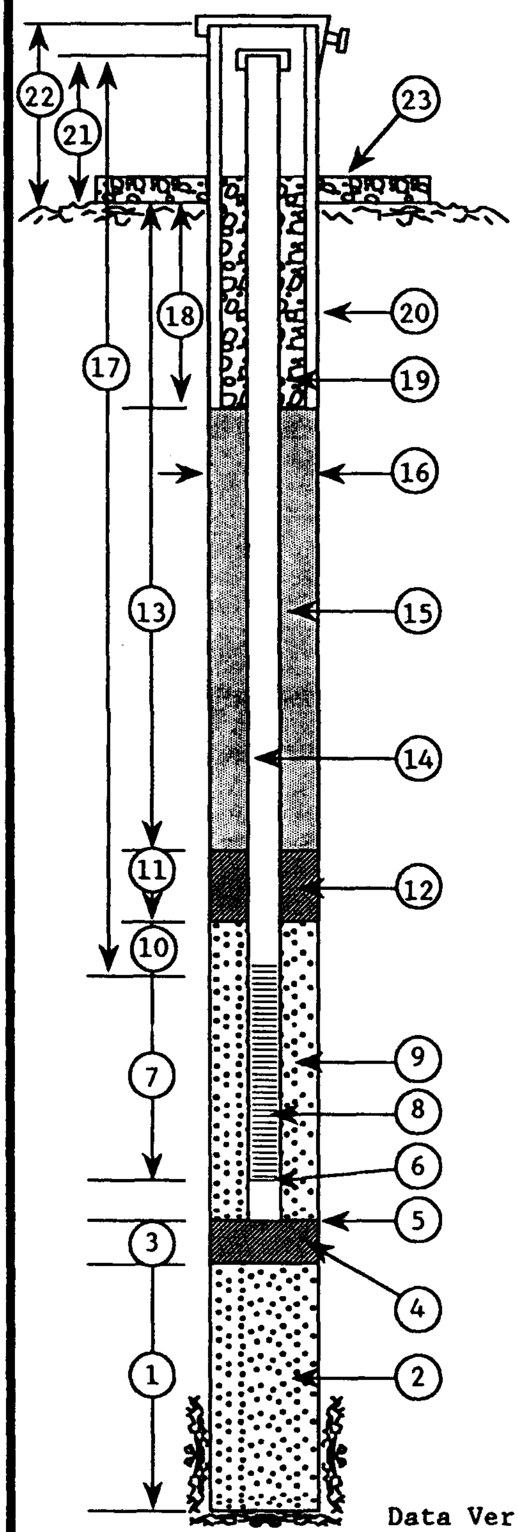
1. DEPTH OF BOREHOLE 19 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 19 FEET.
6. DEPTH TO TOP OF SUMP: 18 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 18 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 13 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 11 FEET.
12. TYPE OF UPPER SEAL: BENTONITE.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 10 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 15 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 3 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.8 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brett R. [signature] Date 31 May 1990
Data Reviewed by [signature] Date 31 May 90

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 7-3

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD
INSTALLATION TEAM:
TERRY ASBERRY & RUSS DEIKE

GROUND SURFACE ELEVATION: 23.73
TOP OF WELL CASING ELEVATION: 25.22
START DATE: 8/24/89 TIME: 1115
END DATE: 8/24/89 TIME: 1600



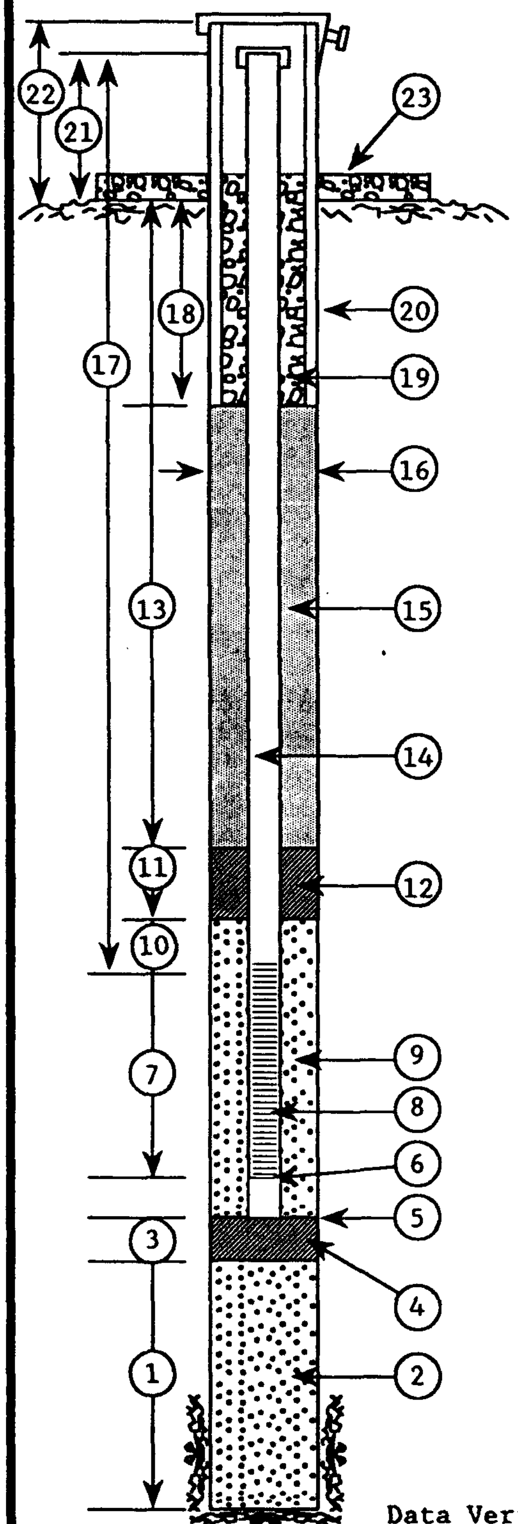
1. DEPTH OF BOREHOLE 24 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 24 FEET.
6. DEPTH TO TOP OF SUMP: 23 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 23 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 18 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 16 FEET.
12. TYPE OF UPPER SEAL: BENTONITE.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 14 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 19.5 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 3 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.5 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified Brent R. [signature] Date 31 May 1990
Data Reviewed by [signature] Date 31 May 90

SAIC	MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MW 7-4

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
TERRY ASBURY & RUSS DEIKE

GROUND SURFACE ELEVATION: 22.24
TOP OF WELL CASING ELEVATION: 23.80
START DATE: 8/25/89 TIME: 0740
END DATE: 8/25/89 TIME: 1700



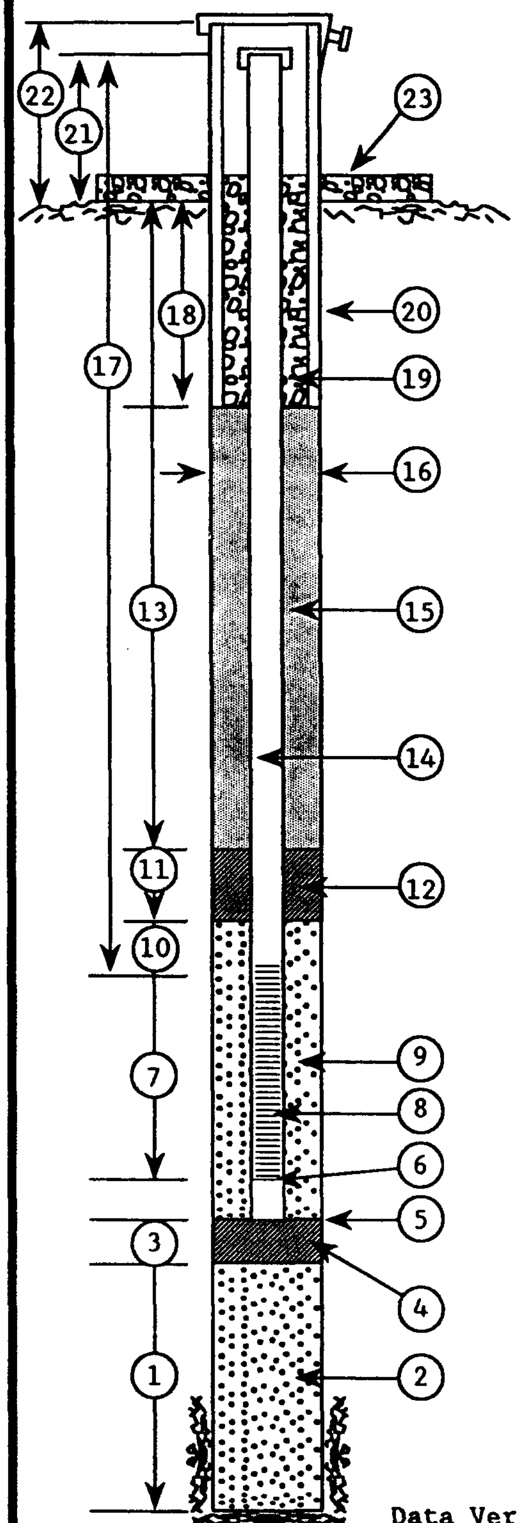
1. DEPTH OF BOREHOLE 20 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 19.5 FEET.
6. DEPTH TO TOP OF SUMP: 18.5 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 18.5 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 13.5 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 11 FEET.
12. TYPE OF UPPER SEAL: BENTONITE.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 10 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 15 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 2 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 1.6 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified *Brent R. [signature]* Date 31 May 1990
Data Reviewed by *[signature]* Date 31 May 90

MONITORING WELL INSTALLATION LOG	BOREHOLE/WELL NUMBER: MWBG

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
INSTALLATION TEAM:
TERRY ASBERRY & RUSS DEIKE

GROUND SURFACE ELEVATION: 24.65
TOP OF WELL CASING ELEVATION: 25.59
START DATE: 8/22/89 TIME: 1140
END DATE: 8/22/89 TIME: 1500



1. DEPTH OF BOREHOLE 21.5 FEET.
2. TYPE OF LOWER BACKFILL: NATURAL.
3. DEPTH TO BOTTOM OF BOTTOM SEAL: NO SEAL FEET.
4. TYPE OF BOTTOM SUMP: PVC SUMP.
5. DEPTH TO BOTTOM OF SUMP 20 FEET.
6. DEPTH TO TOP OF SUMP: 19 FEET.
7. DEPTH TO BOTTOM OF WELL SCREEN 19 FEET.
8. TYPE OF SCREEN MATERIAL: SCH 40 PVC.
   DIAMETER OF SCREEN 4 INCH. SLOT SIZE OF SCREEN 0.010 INCH.
9. TYPE OF PACK AROUND WELL POINT: 10-20 SAND.
10. DEPTH TO TOP OF WELL POINT OR SCREEN 14 FEET.
11. DEPTH TO BOTTOM OF TOP SEAL (If Installed) 13 FEET.
12. TYPE OF UPPER SEAL: BENTONITE PELLETS.
13. DEPTH TO TOP OF TOP SEAL (If Installed) 12 FEET.
14. TYPE OF RISER PIPE MATERIAL: SCH 40 PVC.
    DIAMETER OF RISER PIPE 4 INCH.
15. TYPE OF UPPER BACKFILL: CEMENT-BENTONITE SLURRY.
16. BOREHOLE DIAMETER 11.75 INCH.
17. TOTAL LENGTH OF RISER PIPE 15 FEET.
18. DEPTH TO BOTTOM OF UPPER SEAL/PROTECTIVE CASING 3 FEET.
19. TYPE OF UPPER SEAL: CEMENT.
20. TYPE OF WELL COVER: CARBON STEEL.
    DIAMETER OF WELL COVER 8 INCH.
21. HEIGHT OF WELL CASING ABOVE GROUND 0.9 FEET.
22. PROTECTIVE CASING? YES.
    HEIGHT ABOVE GROUND 2 FEET.
    LOCKING CAP? YES.
23. CONCRETE CAP? YES.

Data Verified [signature] Date 31 May 90
Data Reviewed by [signature] Date 31 May 90

SAIC®	FIELD BOREHOLE LOG	BOREHOLE NUMBER: MW 1-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
LOCATION: Portland, Oregon
DRILLING COMPANY: Soil Sampling Services, Inc.
RIG TYPE/NUMBER: Mobil B-61/20
DRILLING METHOD: Hollow Stem Auger
WEATHER: Clear, Mid 40's
FIELD PARTY: Paul Montgomery & Wayne Lindholm
GEOLOGIST: Brett Freier
DATE BEGUN: 12/14/88 DATE COMPLETED: 12/14/88

FIELD BOOK NO: 1
TOTAL DEPTH: 15.0 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling		AB=After Boring
Depth(ft)	7-8 WD	
Time	1200	
Date	12/14	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	1	17/12/16		8"	0.0		D	L	0	SANDY SILT, v dk gray (10 YR 3/1), v fn to	12/14
					0.5					fn sand, some coal in top 2", cse gravel	
					1.0					in top 6", (G-M)	
					1.5						
					2.0						
					2.5						
					3.0						
					3.5					SILTY CLAY, v little cse material	
					4.0						
					4.5						
Ss	2	1/1/1		0"	5.0					Could not recover a sample, even though	
					5.5					spoon drove easily	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	3	1/3/2		18"	10.0		W	F	0	SILTY SAND, v dk gray (10 YR 3/1), v fn	12/14
					10.5					sand, no cse material, (CL)	
					11.0						
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	4	1-12"/2		18"	15.0		VW	F	0	As above - however, sand begins to coarsen	12/14
										to fn sand	
										TOTAL DEPTH - 15 FEET	

SAIC	FIELD BOREHOLE LOG	BOREHOLE NUMBER: MW 2-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
LOCATION: Portland, Oregon
DRILLING COMPANY: Soil Sampling Services, Inc.
RIG TYPE/NUMBER: Mobil B-61/20
DRILLING METHOD: Hollow Stem Auger
WEATHER: Clear, Mid 40's
FIELD PARTY: Paul Montgomery & Wayne Lindholm
GEOLOGIST: Brett Freier
DATE BEGUN: 12/16/88 DATE COMPLETED: 12/16/88

FIELD BOOK NO: 1
TOTAL DEPTH: 13.5 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	6 WD	
Time	0800	
Date	12/16/88	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	1	5/5/5		8"	0.0		M	F	0	CLAY, v dk grayish brown (10 YR 3/2), sm	12/16
					0.5					silt present, sl mottled (appears to be	
					1.0					iron staining), (CL)	
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	2	1/2/2		18"	5.0		M	F	0	CLAYEY SILT, v dk grayish brn (2.5 YR 3/2)	12/16
					5.5					no cse material, sl plastic, (CL)	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	3	0-18"		18"	10.0		W	F	0	SILTY SAND, v dk gray (10 YR 3/1), v fn	12/16
					10.5					sand, no cse material, (CL)	
					11.0						
					11.5						
					12.0						
					12.5						
					13.0						
					13.5					TOTAL DEPTH - 13.5 FEET	

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 2-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: OVERCAST, MID 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/23/89 DATE COMPLETED: 8/23/89

FIELD BOOK NO: 1
TOTAL DEPTH: 15.0 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	8 WD	
Time	0800	
Date	8/23/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	1	1/2/1		18"	5.0		M	F	0	CLAYEY SAND, v dark grayish brn (10 YR 3/2	8/23
					5.5					v fn to fn sand - mostly clay, no cse	
					6.0					material, sl plastic, (CL)	
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	2	1/1/1		18"	10.0		M	F	0	SILTY SAND, v dark gray (10 YR 3/1), v fn	8/23
					10.5					to fn sand, no cse material, (CL)	
					11.0						
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	3	0-12"		18"	15.0		W	F	0	SILTY SAND, v dark gray (10 YR 3/1), as	8/23
		1-6"								above but sl cser, (CL)	
										TOTAL DEPTH - 15 FEET	

SAIC

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 3-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
LOCATION: Portland, Oregon
DRILLING COMPANY: Soil Sampling Services, Inc.
RIG TYPE/NUMBER: Mobil B-61/20
DRILLING METHOD: Hollow Stem Auger
WEATHER: Clear, Low 40's
FIELD PARTY: Paul Montgomery & Wayne Lindholm
GEOLOGIST: Brett Freier
DATE BEGUN: 12/15/88 DATE COMPLETED: 12/15/88

FIELD BOOK NO: 1
TOTAL DEPTH: 15.0 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	7 WD	
Time	1100	
Date	12/15/88	

Location Diagram:

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Description	Date
Ss	1	4/5/7		9"	0.0		M	L	0	SANDY SILT, dk brown (10 YR 3/3), v fn to	12/15
					0.5					fn sand, no cse material, (CL)	
					1.0						
					1.5						
					2.0						
					2.5						
					3.0					Gravel layer encountered, v cse pebbles to	
					3.5					small gravel - gone by about 4 feet	
					4.0						
					4.5						
Ss	2	4/5/8		18"	5.0		M	F	0	SILTY CLAY, v dk gray (10 YR 3/1), some	12/15
					5.5					mottling present, no cse material (CL)	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	3	1/1/2		18"	10.0		W	F	0	SILTY SAND, v dk grayish brn (2.5 Y 3/2),	12/15
					10.5					v fn to fn sand, no cse material, (CL)	
					11.0						
					11.5						
					12.0					Transition to sl cser sand at 12 feet	
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	4	1/1/4		18"	15.0		VW	F	0	SILTY SAND, v dk gray (10 YR 3/1), v fn to	12/15
										fn sand, no cse material, (CL)	
										TOTAL DEPTH - 15 FEET	

SAIC

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 5-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
LOCATION: Portland, Oregon
DRILLING COMPANY: Soil Sampling Services, Inc.
RIG TYPE/NUMBER: Mobil B-61/20
DRILLING METHOD: Hollow Stem Auger
WEATHER: Clear, Low 40's
FIELD PARTY: Paul Montgomery & Wayne Lindholm
GEOLOGIST: Brett Freier
DATE BEGUN: 12/16/88 DATE COMPLETED: 12/17/88

FIELD BOOK NO: 1
TOTAL DEPTH: 15.0 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling AB=After Boring		
Depth(ft)	6 AB	
Time	0745	
Date	12/17/89	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	1	4/8/9		18"	0.0		SM	S	0	SILTY CLAY, v dk grayish brown (10 YR 3/2)	12/16
					0.5					some mica, plant roots, (CL)	
					1.0						
					1.5						
					2.0						
					2.5						
					3.0					Brown clay, slightly mottled w/iron stains	
					3.5						
					4.0						
					4.5						
Ss	2	4/4/4		18"	5.0		VM	S	0	CLAY, grayish brn (2.5 Y 5/2), sl mottling	12/16
					5.5					to a gray CLAY (2.5 Y N 4/), (CL)	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0					Transition to v fn sand	
					8.5						
					9.0						
					9.5						
Ss	3	1/1/1		18"	10.0		VW	F	0	SILTY SAND, v dk gray (10 YR 3/1), v fn	12/16
					10.5					sand, no cse material, (CL)	
					11.0						
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	4	1/1/3		18"	15.0		VW	F	0	Same description as above at 10 feet.	12/16
										TOTAL DEPTH - 15 FEET	

FIELD BOREHOLE LOG

SAIC

BOREHOLE NUMBER: MW 5-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: Oregon Air National Guard SI
LOCATION: Portland, Oregon
DRILLING COMPANY: Soil Sampling Services, Inc.
RIG TYPE/NUMBER: Mobil B-61/20
DRILLING METHOD: Hollow Stem Auger
WEATHER: Clear, Mid 40's
FIELD PARTY: Paul Montgomery & Wayne Lindholm
GEOLOGIST: Brett Freier
DATE BEGUN: 12/17/88 DATE COMPLETED: 12/17/88

FIELD BOOK NO: 1
TOTAL DEPTH: 12.0 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	7 WD	
Time	1130	
Date	12/17/88	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	1	4/6/6	↓	6"	0.0		SM	F	0	SANDY CLAY, v dk grayish brn (10 YR 3/2),	12/17
					0.5					v fn sand, some cse pebbles, (CL)	
					1.0						
					1.5						
					2.0					Transition to brown silty clay, dk brown	
					2.5					(10 YR 3/3), (CL)	
					3.0						
					3.5						
					4.0						
					4.5						
Ss	2	2/2/2	↓	18"	5.0		W	F	0	SILTY SAND, dk brown (10 YR 3/3), v fn to	12/17
					5.5					fn sand, no cse material, (CL)	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	3	1-6"	↓	18"	10.0		W	F	0	As described above at 5 feet.	12/17
		1-12"			10.5						
					11.0						
					11.5						
					12.0					TOTAL DEPTH - 12 FEET	

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 7-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: OVERCAST, UPPER 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/23/89 DATE COMPLETED: 8/23/89

FIELD BOOK NO: 1
TOTAL DEPTH: 25.0 Ft
SHEET 1 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	22 WD	
Time	1200	
Date	8/23/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	1	3/4/4	↓	18"	5.0		D	L	0	SILTY SAND, v dark gray (10 YR 3/1), v fn	8/23
					5.5					to fn sand, mod cohesive, no cse material,	
					6.0					(CL)	
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	2	2/2/1	↓	18"	10.0		SM	F	0	SILTY SAND, v dark gray (10 YR 3/1), v fn	8/23
					10.5					to fn sand, no cse material,	
					11.0					(CL)	
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0					Grades into brown clay at 14'	
					14.5						
Ss	3	1-18"	↓	18"	15.0		VW	F	0	SANDY SILT, v dark grayish brown (10 YR	8/23
					15.5					3/2), no cse material, some clay,	
					16.0					(CL)	
					16.5						
					17.0						
					17.5						
					18.0						
					18.5						
					19.0						

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER:
MW 7-1

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: OVERCAST, UPPER 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/23/89 DATE COMPLETED: 8/23/89

FIELD BOOK NO: 1
TOTAL DEPTH: 25.0 Ft
SHEET 2 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	22 WD	
Time	1200	
Date	8/23/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	4	1/4/4		18"	20.0		VM	S	0	SANDY SILTY CLAY, v dark gray (10 YR 3/1),	8/23
					20.5					v fn to fn sand, some clay,	
					21.0					(CL)	
					21.5						
					22.0					At 22' encountered very tight gray clay as	
					22.5					reported by the driller and seen in sample	
					23.0					number 5, described below	
					23.5						
					24.0						
					24.5						
Ss	5	1/2/2		18"	25.0		VM	F	0	SILTY CLAY, v dark gray (10 YR 3/1), no cs	8/23
										material, (CL)	
										TOTAL DEPTH - 25 FEET	

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 7-2

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: PARTLY CLOUDY, MID 50's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/24/89 DATE COMPLETED: 8/24/89

FIELD BOOK NO: 1
TOTAL DEPTH: 16.5 Ft
SHEET 1 OF 1

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	10 WD	
Time	0800	
Date	8/24/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	1	2/2/2		18"	5.0		SM	MD	0	SANDY CLAY, v dk yellowish brown (10 YR	8/24
					5.5					3/6), v fn to fn sand, no cse material,	
					6.0					(CL)	
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	2	1-9"		18"	10.0		VW	S	0	SANDY SILT, v dark grayish brn (10 YR 3/2)	8/24
		1-9"			10.5					v fn to fn sand, mica flakes visible, no	
					11.0					cse material, (CL)	
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	3	3/3/5		18"	15.0		VW	L	0	As described at the 10' interval. At 16'	8/24
					15.5					a cse sand was encountered - very angular	
					16.0					with moderate sorting.	
Ss	4	3/4/5		4"	16.5		VW	L	0	SANDY SILT, v dk gray (10 YR 3/1), mostly	8/24
										fn sand, v little cse material, (CL)	
										TOTAL DEPTH - 18 FEET	

SAIC

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 7-3

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: PARTLY CLOUDY, MID 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/24/89 DATE COMPLETED: 8/24/89

FIELD BOOK NO: 1
TOTAL DEPTH: 24.0 Ft
SHEET 1 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	17 WD	
Time	1145	
Date	8/24/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	1	2/2/3		18"	5.0		D	L	0	SILTY SAND, v dk yellowish brn (10 YR 3/4)	8/24
					5.5					v fn to fn sand, no cse material, (CL)	
					6.0						
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	2	2/2/2		18"	10.0		W	F	0	SILTY SAND, dk yellowish brn (10 YR 3/4),	8/24
					10.5					v fn to fn sand, no cse material, (CL),	
					11.0					saturated at 11'	
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	3	1-6"		18"	15.0		W	S	0	SILTY SAND, v dk gray (10 YR 3/1), v fn to	8/24
		2-12"			15.5					fn sand, no cse material, saturated but	
					16.0					poor water yield, (CL)	
					16.5						
					17.0						
					17.5						
					18.0						
					18.5						
					19.0						

SAIC®	FIELD BOREHOLE LOG	BOREHOLE NUMBER: MW 7-3

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: PARTLY CLOUDY, MID 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/24/89 DATE COMPLETED: 8/24/89

FIELD BOOK NO: 1
TOTAL DEPTH: 24.0 Ft
SHEET 2 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	17 WD	
Time	1145	
Date	8/24/89	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	4	0-6"		18"	20.0		VW	F	0	SILTY SAND, as above w/ slightly more cse	8/24
		1-12"			20.5					sand, (CL)	
					21.0						
					21.5						
Ss	5	2/2/1		18"	22.0		VW	F	0	SAND, cse sand to 24',	8/24
					22.5					(CL)	
					23.0						
					23.5						
					24.0					Drill cuttings showed a return to SILTY	
										SAND at 24'.	
										TOTAL DEPTH - 24 FEET	

SAIC	FIELD BOREHOLE LOG	BOREHOLE NUMBER: MW 7-4

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: CLEAR, MID 70's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/25/89 DATE COMPLETED: 8/25/89

FIELD BOOK NO: 1
TOTAL DEPTH: 20.0 Ft
SHEET 1 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	13 WD	
Time	0800	
Date	8/25/89	

Sampling Method	Sampling: Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
					2.0						
					2.5						
					3.0						
					3.5						
					4.0						
					4.5						
Ss	1	2/4/4		18"	5.0		D	L	0	SILTY CLAY, dk grayish brown (2.5 Y 5/2),	8/25
					5.5					some fn sand, no cse material,	
					6.0					(CL)	
					6.5						
					7.0						
					7.5						
					8.0						
					8.5						
					9.0						
					9.5						
Ss	2	1/1/2		18"	10.0		W	F	0	SILTY CLAY, as described above from 10.0 t	8/25
					10.5					11.0 ft. At 11', SILTY SAND, v dk grayish	
					11.0					brn (2.5 Y 3/2), no cse material, (CL)	
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	3	3/5/4		18"	15.0		VW	F	0	Cse sand encountered at 16 ft. Little or	8/25
					15.5					no fines, sand is angular and exhibits	
					16.0					moderate sorting	
					16.5						
					17.0						
					17.5						
					18.0						
					18.5						
					19.0						

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FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW 7-4

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: CLEAR, MID 70's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/25/89 DATE COMPLETED: 8/25/89

FIELD BOOK NO: 1
TOTAL DEPTH: 20.0 Ft
SHEET 2 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	13 WD	
Time	0800	
Date	8/25/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	4	NR		14"	20.0		VW	F	0	SILTY SAND, v dk grayish brn (2.5 Y 3/2),	8/25
										v fn to fn sand, no cse material, (CL)	
										TOTAL DEPTH - 20.0 FEET	

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MWBG

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: OVERCAST, MID 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/22/89 DATE COMPLETED: 8/22/89

FIELD BOOK NO: 1
TOTAL DEPTH: 20.0 Ft
SHEET 1 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	12 WD	
Time	1210	
Date	8/22/89	

Sampling Method	Sample No.	Blow Count	Loc. Sampled	Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
					0.0						
					0.5						
					1.0						
					1.5						
Ss	1	6/5/5	↓	14"	2.0		D	L	0	SANDY SILT, dark yellowish brn (10 YR 4/4)	8/22
					2.5					v fn to fn sand w/ some cse cobbles,	
					3.0					(CL)	
					3.5						
					4.0						
					4.5						
					5.0						
					5.5						
					6.0						
					6.5						
					7.0						
					7.5						
Ss	2	3/5/8	↓	18"	8.0		M	F	0	SILTY CLAY, v dark grayish brn (10 YR 3/2)	8/22
					8.5					no cse material,	
					9.0					(CL)	
					9.5						
					10.0						
					10.5						
					11.0						
					11.5						
					12.0						
					12.5						
					13.0						
					13.5						
					14.0						
					14.5						
Ss	3	0-18"	↓	18"	15.0		VW	S	0	As described in the 8' sample.	8/22
					15.5						
					16.0						
					16.5						
					17.0						
					17.5						
					18.0						
					18.5						
					19.0						

SAIC®

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MWBG

PROJECT NUMBER: 1-817-03-471
PROJECT NAME: OREGON AIR NATIONAL GUARD SI
LOCATION: PORTLAND, OREGON
DRILLING COMPANY: SOIL SAMPLING SERVICES, INC.
RIG TYPE/NUMBER: MOBIL B-61/24
DRILLING METHOD: HOLLOW STEM AUGER
WEATHER: OVERCAST, MID 60's
FIELD PARTY: TERRY ASBERRY & RUSS DEIKE
GEOLOGIST: BRETT FREIER
DATE BEGUN: 8/22/89 DATE COMPLETED: 8/22/89

FIELD BOOK NO: 1
TOTAL DEPTH: 20.0Ft
SHEET 2 OF 2

STATIC WATER LEVEL (BLS)		
WD=While Drilling	AB=After Boring	
Depth(ft)	12 WD	
Time	1210	
Date	8/22/89	

Sampling Method	Sampling: Sample No.	Sampling: Blow Count	Sampling: Loc. Sampled	Sampling: Recovery	Depth in Feet (BLS)	Soil Graph	Moisture	Consistency	Organic Vapor	Location Diagram:	Date
Ss	4	0-18"		18"	20.0		VW	S	0	SILTY SAND, v dark gray (10 YR 3/1), v fn	8/22
										to fn sand, no cse material, (CL),	
										TOTAL DEPTH - 20 FEET	

APPENDIX C

SLUG TEST DATA AND DERIVED COEFFICIENTS

APPENDIX C

SLUG TEST DATA AND DERIVED COEFFICIENTS

SLUG TEST METHODOLOGY AND EXAMPLE CALCULATION

Slug tests were chosen over pump tests to provide information on aquifer characteristics because it was judged that the fine-grained sediments of the Floodplain Aquitard would not allow the unit to be pumped at a rate such that an observed change in water level would be detected in neighboring wells. Slug tests were performed using the following equipment:

- Centrifugal pump and dedicated suction tubing
- Instrumentation Northwest, Inc.™ data logger and pressure transducer
- Lap top personal computer

The slug tests were performed using the following procedures. The pressure transducer was placed at the bottom of the well. It was ensured that the end of the discharge tubing was above the pressure transducer. This was necessary to make certain that a reference point was used for all subsequent water level measurements. The pump was then turned on, and the system was monitored to provide the operator with continuous water level measurements. When the water level reached a point near the bottom of the discharge tubing, the pump was shut off and the formation was allowed to recover to its static water level. Water level measurements were collected on programmed intervals until the formation returned to approximately 90 percent of its previously indicated static water level. At this point, the data was examined to ensure that a representative test was recorded and the information was then stored on a standard 3.5-inch computer disk.

The well-recovery data was interpreted using the method of Hvorslev (1951). This method provides a straight-forward technique for interpreting slug tests. Ideally, a plot of the well-recovery data verses time will produce a straight-line when plotted on a semi-log scale. However, when there is a great deal of physical difference between the well pack (sand) and the formation (silts or sandy silts) a curve will result. The procedure for interpreting the resulting curve is to pick the straight-line portion of the curve believed to be representative of the recovery of the formation and not of the sand pack. Generally, for the above mentioned situation, this will not be the initial response of the aquifer because this is probably greatly influenced by draining water from the sand pack. For example, the recovery curve for MW1-2 shows a rapid initial recovery due to draining the sand pack and further down the curve a second straight-line can be drawn which represents recovery of the formation. The Hvorslev method provides a means to correct for the "time lag" (T_0) caused by this physical difference (see Freeze and Cherry, 1979, for additional information). Correcting for the time lag requires that the straight-line drawn through a portion of the curve intercept the y-axis at $T = 0$. The resulting straight-line represents the recovery of the formation and not the sand pack. In order to conveniently solve the

differential equation relating T_0 to $H-H_0/H-h$, T_0 is determined graphically at the point where $LN(H-H_0/H-h)$ equals -1. After selecting T_0, the following equation may be solved for the hydraulic conductivity, K:

$$K = \frac{r^2 LN(L/R)}{2LT_0}$$

where, L = length of screen = 5 ft
R = radius of borehole = 0.5 ft
r = radius of casing = 2 inches = 0.167 ft

For example, using the data from the slug test for MW1-2 (T_0 = 1,420 seconds) and solving the above equation for K, yields the following:

$$K = \frac{(0.167)^2 LN(5/0.5)}{2(5)(1,420)}$$

$K = 4.51 \times 10^{-6}$ ft/s or 1.37×10^{-4} cm/s.

MW1-1 SLUG TEST DATA

Date	Time	h	(H-h/H-Ho)	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/89	15:23:45	5.5512188417	0		
08/26/89	15:23:48	4.3240313214	0.3096539		
08/26/89	15:23:50	3.6093750596	0.4899816		
08/26/89	15:23:52	2.8514062971	0.68123861		
08/26/89	15:23:54	2.2305937868	0.818875636		
08/26/89	15:23:56	1.5881250262	1	0	0
08/26/89	15:23:58	1.6097812766	0.9945355191	-0.0054794658	2
08/26/89	15:24:00	1.6314375269	0.9890710383	-0.0109891216	4
08/26/89	15:24:02	1.6819687778	0.9763205829	-0.0239642804	6
08/26/89	15:24:05	1.7685937792	0.9544626594	-0.0466067572	9
08/26/89	15:24:07	1.81912503	0.941712204	-0.060055567	11
08/26/89	15:24:08	1.8696562809	0.9289617486	-0.0736877158	12
08/26/89	15:24:10	1.9201875317	0.9162112933	-0.0875082714	14
08/26/89	15:24:12	1.9635000324	0.9052823315	-0.0995084154	16
08/26/89	15:24:14	2.0140312833	0.8925318761	-0.1136930504	18
08/26/89	15:24:16	2.057343784	0.8816029144	-0.1260135348	20
08/26/89	15:24:18	2.1006562847	0.8706739526	-0.138487709	22
08/26/89	15:24:20	2.1367500353	0.8615664845	-0.149003053	24
08/26/89	15:24:21	2.1728437859	0.8524590164	-0.1596301456	25
08/26/89	15:24:24	2.2233750367	0.839708561	-0.1747003985	28
08/26/89	15:24:29	2.2811250377	0.825136612	-0.192206316	33
08/26/89	15:24:34	2.3533125389	0.8069216758	-0.2145286715	38
08/26/89	15:24:39	2.4110625398	0.7923497268	-0.2327524104	43
08/26/89	15:24:44	2.4760312909	0.7759562842	-0.2536590952	48
08/26/89	15:24:49	2.5337812918	0.7613843352	-0.272617009	53
08/26/89	15:24:53	2.605968793	0.7431693989	-0.2968312671	58
08/26/89	15:24:59	2.6492812937	0.7322404372	-0.3116463529	63
08/26/89	15:25:04	2.7214687949	0.7140255009	-0.3368366017	68
08/26/89	15:25:09	2.786437546	0.6976320583	-0.3600634523	73
08/26/89	15:25:14	2.8514062971	0.6812386157	-0.3838426441	78
08/26/89	15:25:24	2.9741250491	0.650273224	-0.4303626597	88
08/26/89	15:25:34	3.0968438011	0.6193078324	-0.4791528239	98
08/26/89	15:25:44	3.1979063028	0.5938069217	-0.5212010601	108
08/26/89	15:25:54	3.2917500544	0.5701275046	-0.561895251	118
08/26/89	15:26:04	3.4000313062	0.5428051002	-0.611004955	128
08/26/89	15:26:14	3.4938750577	0.5191256831	-0.6556092612	138
08/26/89	15:26:24	3.5805000591	0.4972677596	-0.6986266463	148
08/26/89	15:26:34	3.6815625608	0.4717668488	-0.7512703798	158
08/26/89	15:26:44	3.7681875622	0.4499089253	-0.7987101049	168
08/26/89	15:26:54	3.8548125637	0.4280510018	-0.8485129274	178
08/26/89	15:27:24	4.0930313176	0.3679417122	-0.9998307441	208
08/26/89	15:27:54	4.3023750711	0.3151183971	-1.154806847	238
08/26/89	15:28:24	4.482843824	0.2695810565	-1.3108861678	268
08/26/89	15:28:53	4.6849688274	0.218579235	-1.5206066987	298
08/26/89	15:29:24	4.8726563305	0.1712204007	-1.7648036592	328
08/26/89	15:29:54	5.0170313328	0.1347905282	-2.0040333483	358
08/26/89	15:30:24	5.1686250854	0.0965391621	-2.337806528	388
08/26/89	15:30:54	5.2913438374	0.0655737705	-2.724579503	418
08/26/89	15:31:24	5.4068438393	0.0364298725	-3.312366168	448

MW1-2 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/80	14:23:24	7.1321251178			
08/26/80	14:23:26	7.1032501173	0.008908686	-4.7207285264	
08/26/80	14:23:28	7.0671563667	0.0200445434	-3.9097983105	
08/26/80	14:23:30	6.9733126152	0.0200445434	-3.9097983105	
08/26/80	14:23:32	6.7784063619	0.1091314031	-2.2152025897	
08/26/80	14:23:34	6.4319063562	0.2160356347	-1.5323119092	
08/26/80	14:23:35	5.9482500982	0.3652561247	-1.0071564599	
08/26/80	14:23:39	4.9376250815	0.6770601336	-0.3899951863	
08/26/80	14:23:40	4.3168125713	0.868596882	-0.1408761486	
08/26/80	14:23:42	3.9053438145	0.995545657	-0.0044642931	
08/26/80	14:23:44	3.8909063143	1	0	0
08/26/80	14:23:46	3.9630938155	0.9777282851	-0.0225234747	2
08/26/80	14:23:48	4.0641563171	0.9465478842	-0.0549337188	4
08/26/80	14:23:50	4.1652188188	0.9153674833	-0.0884296732	6
08/26/80	14:23:52	4.2662813205	0.8841870824	-0.1230866071	8
08/26/80	14:23:55	4.4467500734	0.8285077951	-0.1881290335	11
08/26/80	14:23:56	4.5478125751	0.7973273942	-0.2264899013	12
08/26/80	14:23:58	4.6344375765	0.7706013363	-0.2605841127	14
08/26/80	14:24:00	4.721062578	0.7438752784	-0.2958818948	16
08/26/80	14:24:02	4.8293438298	0.710467706	-0.341831785	18
08/26/80	14:24:06	5.0314688331	0.6481069042	-0.4336996206	22
08/26/80	14:24:11	5.2335938364	0.5857461024	-0.5348688556	27
08/26/80	14:24:17	5.4140625894	0.5300668151	-0.6347522141	33
08/26/80	14:24:22	5.5656563419	0.4832962138	-0.7271255342	38
08/26/80	14:24:27	5.6955938441	0.4432071269	-0.813718063	43
08/26/80	14:24:32	5.811093846	0.4075723831	-0.8975367349	48
08/26/80	14:24:36	5.9049375975	0.3786191537	-0.9712244507	52
08/26/80	14:24:41	5.9771250987	0.3563474388	-1.0318490725	57
08/26/80	14:24:46	6.0420938498	0.3363028953	-1.0897430509	62
08/26/80	14:24:52	6.0998438507	0.3184855234	-1.1441782575	68
08/26/80	14:25:02	6.179250102	0.293986637	-1.2242209652	78
08/26/80	14:25:12	6.2297813529	0.2783964365	-1.2787091504	88
08/26/80	14:25:22	6.2730938536	0.2650334076	-1.3278993946	98
08/26/80	14:25:31	6.3019688541	0.2561247216	-1.3620907594	107
08/26/80	14:25:42	6.3236251044	0.2494432071	-1.3885240165	114
08/26/80	14:25:52	6.3380626047	0.2449888641	-1.4065425219	124
08/26/80	14:26:01	6.3669376051	0.2360801782	-1.4435837936	133
08/26/80	14:26:11	6.3813751054	0.2316258352	-1.4626319886	143
08/26/80	14:26:22	6.3958126056	0.2271714922	-1.4820500744	153
08/26/80	14:26:32	6.3958126056	0.2271714922	-1.4820500744	163
08/26/80	14:27:02	6.4246876061	0.2182628062	-1.5220554091	193
08/26/80	14:27:31	6.4463438564	0.2115812918	-1.5531459961	222
08/26/80	14:28:01	6.4680001068	0.2048997773	-1.5852343107	252
08/26/80	14:28:32	6.4896563572	0.1982182628	-1.618386518	282
08/26/80	14:29:02	6.4968751073	0.1959910913	-1.6296860733	312
08/26/80	14:29:31	6.5113126075	0.1915367483	-1.6526755915	342
08/26/80	14:30:01	6.5185313576	0.1893095768	-1.6643716312	372
08/26/80	14:30:32	6.5329688579	0.1848552339	-1.6881822799	402
08/26/80	14:31:02	6.540187608	0.1826280624	-1.7003036405	432
08/26/80	14:31:32	6.5474063581	0.1804008909	-1.7125737331	472

MW1-2 SLUG TEST DATA

08/26/80	14:32:32	6.5690626085	0.1737193764	-1.7503140611	532
08/26/80	14:33:31	6.597937609	0.1648106904	-1.8029577946	592
08/26/80	14:34:32	6.6268126094	0.1559020045	-1.8585276457	652
08/26/80	14:35:32	6.6412501097	0.1514476615	-1.8875151826	712
08/26/80	14:36:31	6.6701251101	0.1425389755	-1.9481398044	782
08/26/80	14:37:32	6.6845626104	0.1380846325	-1.9798885027	842
08/26/80	14:38:31	6.6990001106	0.1336302895	-2.0126783255	902
08/26/80	14:39:32	6.7134376109	0.1291759465	-2.0465798772	962
08/26/80	14:40:31	6.7350938612	0.1224944321	-2.0996897025	1022
08/26/80	14:41:32	6.7495313615	0.1180400891	-2.1367309742	1082
08/26/80	14:43:32	6.7784063619	0.1091314031	-2.2152025897	1202
08/26/80	14:45:32	6.8000626123	0.1024498886	-2.2783814913	1322
08/26/80	14:47:32	6.8072813624	0.1002227172	-2.300360398	1442
08/26/80	14:49:32	6.843375113	0.0890868597	-2.4181434337	1562
08/26/80	14:51:32	6.8722501135	0.0801781737	-2.5235039492	1682
08/26/80	14:53:32	6.901125114	0.0712694878	-2.6412869849	1802
08/26/80	14:55:32	6.9300001144	0.0623608018	-2.7748183776	1922
08/26/80	14:57:32	6.9372188646	0.0601336303	-2.8111860217	2042
08/26/80	14:59:32	6.9588751149	0.0534521158	-2.9289690574	2162
08/26/80	15:01:32	6.9805313653	0.0467706013	-3.0625004501	2282

MW2-1 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/80	11:15:36	4.7282813281			
08/26/80	11:15:38	4.721062578	0.0038610039		
08/26/80	11:15:40	4.6849688274	0.0231660232		
08/26/80	11:15:41	4.5983438259	0.0694980695		
08/26/80	11:15:44	4.3817813224	0.1853281853		
08/26/80	11:15:46	4.23740632	0.2625482625		
08/26/80	11:15:48	4.0280625665	0.3745173745		
08/26/80	11:15:50	3.8259375632	0.4826254826		
08/26/80	11:15:52	3.6238125598	0.5907335907		
08/26/80	11:15:54	3.4144688064	0.7027027027		
08/26/80	11:15:56	3.2267813033	0.8030888031		
08/26/80	11:15:58	3.0246562999	0.9111969112		
08/26/80	11:16:00	2.8658437973	0.9961389961		
08/26/80	11:16:01	2.8586250472	1	0	0
08/26/80	11:16:04	2.8730625474	0.9922779923	-0.0077519768	3
08/26/80	11:16:06	2.909156298	0.972972973	-0.0273989742	5
08/26/80	11:16:08	2.966906299	0.9420849421	-0.0596598364	7
08/26/80	11:16:10	3.0102187997	0.9189189189	-0.084557388	9
08/26/80	11:16:12	3.0463125503	0.8996138996	-0.1057896081	11
08/26/80	11:16:14	3.0824063009	0.8803088803	-0.1274824327	13
08/26/80	11:16:19	3.1401563019	0.8494208494	-0.1632005153	18
08/26/80	11:16:24	3.1834688026	0.8262548263	-0.1908520467	23
08/26/80	11:16:29	3.2267813033	0.8030888031	-0.219289982	28
08/26/80	11:16:34	3.2556563038	0.7876447876	-0.2387080678	33
08/26/80	11:16:39	3.2845313042	0.7722007722	-0.2585106952	38
08/26/80	11:16:44	3.3061875546	0.7606177606	-0.273624333	43
08/26/80	11:16:49	3.3206250548	0.7528957529	-0.2838285031	48
08/26/80	11:16:54	3.327843805	0.749034749	-0.2889699026	53
08/26/80	11:16:59	3.3350625551	0.7451737452	-0.2941378728	58
08/26/80	11:17:04	3.3495000553	0.7374517375	-0.3045546336	63
08/26/80	11:17:14	3.3711563057	0.7258687259	-0.3203860989	73
08/26/80	11:17:24	3.3855938059	0.7181467181	-0.331081388	83
08/26/80	11:17:34	3.4000313062	0.7104247104	-0.3418923041	93
08/26/80	11:17:44	3.4072500563	0.7065637066	-0.3473419089	103
08/26/80	11:17:54	3.4144688064	0.7027027027	-0.3528213746	113
08/26/80	11:18:04	3.4289063066	0.694980695	-0.3638712108	123
08/26/80	11:18:14	3.4289063066	0.694980695	-0.3638712108	133
08/26/80	11:18:24	3.4361250567	0.6911196911	-0.3694422559	143
08/26/80	11:18:34	3.4433438069	0.6872586873	-0.3750445114	153
08/26/80	11:18:44	3.450562557	0.6833976834	-0.3806783291	163
08/26/80	11:19:14	3.4577813071	0.6795366795	-0.3863440667	193
08/26/80	11:19:44	3.4722188073	0.6718146718	-0.3977727625	223
08/26/80	11:20:14	3.4866563076	0.6640926641	-0.4093335849	253
08/26/80	11:20:44	3.4938750577	0.6602316602	-0.4151645052	283
08/26/80	11:21:14	3.5083125579	0.6525096525	-0.4269293468	313
08/26/80	11:21:44	3.5083125579	0.6525096525	-0.4269293468	343
08/26/80	11:22:14	3.5155313081	0.6486486487	-0.4328640823	373
08/26/80	11:22:44	3.5227500582	0.6447876448	-0.4388342493	403
08/26/80	11:23:14	3.5371875584	0.6370656371	-0.4508825878	433
08/26/80	11:23:44	3.5444063085	0.6332046332	-0.4569616339	473

MW2-1 SLUG TEST DATA

08/26/80	11:24:44	3.5660625589	0.6216216216	-0.4754236967	533
08/26/80	11:25:44	3.573281309	0.6177606178	-0.4816542465	593
08/26/80	11:26:44	3.5877188092	0.61003861	-0.4942330287	653
08/26/80	11:27:44	3.6093750596	0.5984555985	-0.5134029448	713
08/26/80	11:28:44	3.6238125598	0.5907335907	-0.5263901403	773
08/26/80	11:29:44	3.6382500601	0.583011583	-0.5395482249	833
08/26/80	11:30:44	3.6526875603	0.5752895753	-0.5528817558	893
08/26/80	11:31:44	3.6671250606	0.5675675676	-0.5663954749	953
08/26/80	11:32:44	3.6743438107	0.5637065637	-0.57322144	1013
08/26/80	11:33:44	3.6887813109	0.555984556	-0.5870147621	1073
08/26/80	11:35:44	3.7032188112	0.5482625483	-0.6010010041	1193
08/26/80	11:37:44	3.7248750615	0.5366795367	-0.6223541286	1313
08/26/80	11:39:44	3.7465313119	0.5250965251	-0.644173176	1433
08/26/80	11:41:44	3.7609688121	0.5173745174	-0.6589882617	1553
08/26/80	11:43:44	3.7826250625	0.5057915058	-0.6816307385	1673
08/26/80	11:45:44	3.7970625627	0.4980694981	-0.6970156573	1793
08/26/80	11:47:44	3.8115000629	0.4903474904	-0.7126409752	1913
08/26/80	11:49:44	3.8331563133	0.4787644788	-0.7365464961	2033
08/26/80	11:51:44	3.8548125637	0.4671814672	-0.7610375161	2153
08/26/80	11:53:44	3.8692500639	0.4594594595	-0.7777045686	2273
08/26/80	11:58:44	3.9125625646	0.4362934363	-0.829440243	2573
08/26/80	12:03:44	3.9630938155	0.4092664093	-0.8933889676	2873
08/26/80	12:08:44	3.999187566	0.38996139	-0.9417075448	3173
08/26/80	12:13:43	4.0280625665	0.3745173745	-0.9821170832	3473
08/26/80	12:18:44	4.0713750672	0.3513513514	-1.0459685552	3773
08/26/80	12:23:43	4.1146875679	0.3281853282	-1.1141768052	4073
08/26/80	12:28:44	4.1435625684	0.3127413127	-1.162378907	4373
08/26/80	12:33:44	4.1868750691	0.2895752896	-1.2393399482	4673
08/26/80	12:38:43	4.2157500696	0.2741312741	-1.2941481846	4973
08/26/80	12:43:44	4.2518438202	0.2548262548	-1.3671733197	5273
08/26/80	12:53:44	4.3529063219	0.2007722008	-1.6055843431	5873
08/26/80	13:03:44	4.3745625722	0.1891891892	-1.6650077636	6473
08/26/80	13:13:44	4.417875073	0.166023166	-1.795627946	7073
08/26/80	13:23:43	4.4467500734	0.1505791506	-1.8932664156	7673
08/26/80	13:33:43	4.482843824	0.1312741313	-2.0304675371	8273

MW2-2 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/80	09:57:28	9.1894689018			
08/26/80	09:57:30	9.1894689018			
08/26/80	09:57:32	9.1894689018			
08/26/80	09:57:34	9.1894689018			
08/26/80	09:57:36	9.1894689018			
08/26/80	09:57:38	9.203906402			
08/26/80	09:57:40	9.1966876519			
08/26/80	09:57:43	9.1678126514			
08/26/80	09:57:45	9.0090001488			
08/26/80	09:57:46	8.7635626447			
08/26/80	09:57:48	8.4242813891			
08/26/80	09:57:53	7.7096251273			
08/26/80	09:57:58	6.9083438641			
08/26/80	09:58:03	6.1215001011			
08/26/80	09:58:08	5.3924063391			
08/26/80	09:58:13	4.8726563305			
08/26/80	09:58:18	4.5478125751			
08/26/80	09:58:23	4.2590625703			
08/26/80	09:58:28	3.9703125656			
08/26/80	09:58:33	3.6599063104			
08/26/80	09:58:38	3.3422813052			
08/26/80	09:58:48	2.8514062971	1	-1.1102230E-16	0
08/26/80	09:58:58	3.0824063009	0.9652928416	-0.0353237608	10
08/26/80	09:59:08	3.1979063028	0.9479392625	-0.0534648479	20
08/26/80	09:59:18	3.2773125541	0.9360086768	-0.0661305325	30
08/26/80	09:59:28	3.3350625551	0.9273318872	-0.0754437546	40
08/26/80	09:59:38	3.4000313062	0.9175704989	-0.086025864	50
08/26/80	09:59:48	3.450562557	0.909978308	-0.0943345171	60
08/26/80	09:59:58	3.4938750577	0.9034707158	-0.1015115814	70
08/26/80	10:00:08	3.5444063085	0.8958785249	-0.10995045	80
08/26/80	10:00:18	3.573281309	0.8915401302	-0.1148048285	90
08/26/80	10:00:48	3.7104375613	0.8709327549	-0.1381905096	120
08/26/80	10:01:18	3.8187188131	0.8546637744	-0.1570471337	150
08/26/80	10:01:48	3.9197813147	0.8394793926	-0.17497335	180
08/26/80	10:02:18	4.0208438164	0.8242950108	-0.1932267903	210
08/26/80	10:02:48	4.1074688178	0.8112798265	-0.2091422456	240
08/26/80	10:03:18	4.1868750691	0.7993492408	-0.2239573314	270
08/26/80	10:03:48	4.2662813205	0.7874186551	-0.2389952087	300
08/26/80	10:04:18	4.3529063219	0.7744034707	-0.2556622612	330
08/26/80	10:04:48	4.4250938231	0.7635574837	-0.2697668674	360
08/26/80	10:05:18	4.4900625742	0.7537960954	-0.282633378	390
08/26/80	10:06:18	4.6416563266	0.7310195228	-0.3133151126	450
08/26/80	10:07:18	4.7788125789	0.7104121475	-0.3419099879	510
08/26/80	10:08:18	4.9015313309	0.6919739696	-0.3682069402	570
08/26/80	10:09:18	5.024250083	0.6735357918	-0.3952141416	630
08/26/80	10:10:18	5.1397500849	0.6561822126	-0.4213167655	690
08/26/80	10:11:18	5.2480313367	0.6399132321	-0.4464226867	750
08/26/80	10:12:18	5.3563125885	0.6236442516	-0.4721751828	810
08/26/80	10:13:18	5.5800938421	0.590021692	-0.5275959767	870
08/26/80	10:14:18	5.8255313462	0.5531453362	-0.5921344978	930

MW2-2 SLUG TEST DATA

08/26/80	10:15:18	6.0493125999	0.5195227766	-0.6548446261	990
08/26/80	10:17:18	6.4463438564	0.4598698482	-0.7768117683	1110
08/26/80	10:19:18	6.7928438622	0.4078091106	-0.8969560802	1230
08/26/80	10:21:18	7.0960313672	0.3622559653	-1.0154042306	1350
08/26/80	10:23:18	7.3559063715	0.3232104121	-1.129451737	1470
08/26/80	10:25:18	7.6013438755	0.2863340564	-1.2505961204	1590
08/26/80	10:27:18	7.8034688789	0.2559652928	-1.3627134185	1710
08/26/80	10:29:18	7.9622813815	0.2321041215	-1.4605692085	1830
08/26/80	10:31:18	8.1355313843	0.2060737527	-1.5795211514	1950
08/26/80	10:33:18	8.2871251369	0.18329718	-1.6966465086	2070
08/26/80	10:35:18	8.4098438889	0.1648590022	-1.8026647027	2190
08/26/80	10:40:18	8.6480626428	0.1290672451	-2.0474217304	2490
08/26/80	11:03:41	9.2905314034	0.032537961	-3.4253478418	3870

MW3-1 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/24/89	16:39:34	3.0679688007			
08/24/89	16:39:49	4.1074688178			
08/24/89	16:41:03	4.4395313233			
08/24/89	16:41:11	4.4395313233			
08/24/89	16:51:24	4.4611875737			
08/24/89	16:51:36	4.4539688236			
08/24/89	16:54:23	4.2735000706			
08/24/89	16:54:39	2.360531289			
08/24/89	16:54:54	1.1983125198	1	-1.1102230E-16	0
08/24/89	16:55:09	1.6386562771	0.8650442478	-0.1449746198	15
08/24/89	16:55:24	1.9274062818	0.7765486726	-0.2528959564	30
08/24/89	16:55:39	2.1006562847	0.7234513274	-0.3237220089	45
08/24/89	16:55:54	2.237812537	0.6814159292	-0.3835823969	60
08/24/89	16:56:09	2.3460937887	0.6482300885	-0.4335095708	75
08/24/89	16:56:24	2.4399375403	0.6194690265	-0.4788925767	90
08/24/89	16:56:39	2.5337812918	0.5907079646	-0.5264335214	105
08/24/89	16:56:54	2.6276250434	0.5619469027	-0.5763479128	120
08/24/89	16:57:09	2.7503437954	0.5243362832	-0.6456220387	135
08/24/89	16:57:24	2.8514062971	0.4933628319	-0.7065104084	150
08/24/89	16:57:39	2.9452500486	0.4646017699	-0.7665746491	165
08/24/89	16:57:54	3.0318750501	0.4380530973	-0.8254151491	180
08/24/89	16:58:09	3.0968438011	0.4181415929	-0.8719351648	195
08/24/89	16:58:24	3.147375052	0.4026548673	-0.9096754928	210
08/24/89	16:58:39	3.1834688026	0.3915929204	-0.9375324473	225
08/24/89	16:58:54	3.2195625532	0.3805309734	-0.966187703	240
08/24/89	16:59:09	3.2556563038	0.3694690265	-0.9956883674	255
08/24/89	16:59:24	3.2845313042	0.360619469	-1.019931979	270
08/24/89	16:59:39	3.3206250548	0.3495575221	-1.0510871468	285
08/24/89	16:59:54	3.3422813052	0.342920354	-1.0702570629	300
08/24/89	17:00:09	3.3783750558	0.3318584071	-1.1030468857	315
08/24/89	17:00:24	3.4144688064	0.3207964602	-1.1369484374	330
08/24/89	17:00:39	3.450562557	0.3097345133	-1.1720397572	345
08/24/89	17:00:54	3.4866563076	0.2986725664	-1.2084074014	360
08/24/89	17:01:09	3.5155313081	0.2898230089	-1.2384848566	375
08/24/89	17:01:24	3.5588438088	0.2765486726	-1.2853684425	390
08/24/89	17:01:39	3.6021563095	0.2632743363	-1.3345586867	405
08/24/89	17:01:54	3.63103131	0.2544247788	-1.3687500515	420
08/24/89	17:02:09	3.6671250606	0.2433628319	-1.413201814	435
08/24/89	17:02:24	3.7032188112	0.232300885	-1.4597218297	450
08/24/89	17:02:39	3.7393125617	0.2212389381	-1.5085119938	465
08/24/89	17:02:54	3.7754063123	0.2101769912	-1.5598052882	480
08/24/89	17:03:09	3.8042813128	0.2013274336	-1.6028226733	495
08/24/89	17:03:24	3.8403750634	0.1902654867	-1.6593348836	510
08/24/89	17:03:39	3.8620313138	0.1836283186	-1.694841572	525
08/24/89	17:03:54	3.8981250644	0.1725663717	-1.7569733531	540
08/24/89	17:04:09	3.9197813147	0.1659292035	-1.7961940663	555
08/24/89	17:04:24	3.9486563152	0.157079646	-1.8510023028	570
08/24/89	17:04:39	3.9703125656	0.1504424779	-1.8941744747	585
08/24/89	17:04:54	3.9847500658	0.1460176991	-1.9240274378	600
08/24/89	17:05:09	4.0064063162	0.139380531	-1.9705474535	615

MW5-1 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/25/89	11:46:26	4.1363438183			
08/25/89	11:46:29	4.0858125675	0.0151187905		
08/25/89	11:46:30	4.0497188169	0.0259179266		
08/25/89	11:46:32	4.0208438164	0.0345572354		
08/25/89	11:46:34	3.9775313157	0.0475161987		
08/25/89	11:46:36	3.9414375651	0.0151187905		
08/25/89	11:46:38	3.8981250644	0.0712742981		
08/25/89	11:46:40	3.8331563133	0.090712743		
08/25/89	11:46:42	3.6887813109	0.1339092873		
08/25/89	11:46:44	3.450562557	0.2051835853		
08/25/89	11:46:45	3.0824063009	0.3153347732		
08/25/89	11:46:49	2.1078750348	0.6069114471		
08/25/89	11:46:50	1.4870625246	0.7926565875		
08/25/89	00:00:00	0.8662500143	0.9784017279		
08/25/89	11:46:54	0.7940625131	1	-1.1102230E-16	0
08/25/89	11:46:56	0.8734687644	0.9762419006	-0.0240448743	2
08/25/89	11:46:58	1.0178437668	0.9330453564	-0.0693014658	4
08/25/89	11:47:00	1.1838750195	0.8833693305	-0.124011898	6
08/25/89	11:47:02	1.3210312718	0.8423326134	-0.171580315	8
08/25/89	11:47:04	1.4365312737	0.807775378	-0.2134712567	10
08/25/89	11:47:09	1.696406278	0.7300215983	-0.3146811586	15
08/25/89	11:47:14	1.876875031	0.6760259179	-0.3915238635	20
08/25/89	11:47:19	1.9923750329	0.6414686825	-0.4439949153	25
08/25/89	11:47:24	2.0862187845	0.6133909287	-0.4887528159	30
08/25/89	11:47:29	2.1511875355	0.5939524838	-0.5209559564	35
08/25/89	11:47:34	2.180062536	0.5853131749	-0.5356082332	40
08/25/89	11:47:39	2.2089375365	0.5766738661	-0.5504783957	45
08/25/89	11:47:44	2.237812537	0.5680345572	-0.5655730219	50
08/25/89	11:47:49	2.2522500372	0.5637149028	-0.5732066468	55
08/25/89	11:47:54	2.2739062875	0.5572354212	-0.5847674692	60
08/25/89	11:48:04	2.2883437878	0.5529157667	-0.5925496096	70
08/25/89	11:48:14	2.3100000381	0.5464362851	-0.6043375654	80
08/25/89	11:48:24	2.3316562885	0.5399568035	-0.6162661362	90
08/25/89	11:48:34	2.3460937887	0.535637149	-0.6242983079	100
08/25/89	11:48:44	2.3677500391	0.5291576674	-0.6364688435	110
08/25/89	11:48:54	2.3821875393	0.524838013	-0.6446656107	120
08/25/89	11:49:04	2.3966250396	0.5205183585	-0.6529301206	130
08/25/89	11:49:14	2.4038437897	0.5183585313	-0.6570881307	140
08/25/89	11:49:24	2.4110625398	0.5161987041	-0.6612635022	150
08/25/89	11:49:34	2.4110625398	0.5161987041	-0.6612635022	160
08/25/89	11:50:04	2.4327187902	0.5097192225	-0.6738952491	190
08/25/89	11:50:34	2.4615937907	0.5010799136	-0.6909896824	220
08/25/89	11:51:04	2.4760312909	0.4967602592	-0.6996477452	250
08/25/89	11:51:34	2.5121250415	0.4859611231	-0.7216266519	280
08/25/89	11:52:04	2.5265625417	0.4816414687	-0.7305552826	320
08/25/89	11:52:34	2.541000042	0.4773218143	-0.7395643526	350
08/25/89	11:53:04	2.5626562923	0.4708423326	-0.7532319913	380
08/25/89	11:53:34	2.5770937926	0.4665226782	-0.7624486464	410
08/25/89	11:54:04	2.5770937926	0.4665226782	-0.7624486464	440
08/25/89	11:54:34	2.5915312928	0.4622030238	-0.7717510391	470

MW5-1 SLUG TEST DATA

08/25/89	11:55:34	2.605968793	0.4578833693	-0.7811407794	530
08/25/89	11:56:34	2.6420625436	0.4470842333	-0.8050082608	590
08/25/89	11:57:34	2.6565000439	0.4427645788	-0.8147170749	650
08/25/89	11:58:34	2.6853750443	0.43412527	-0.834422146	710
08/25/89	11:59:34	2.7214687949	0.4233261339	-0.8596123949	770
08/25/89	12:00:34	2.7647812957	0.4103671706	-0.8907029819	830
08/25/89	12:01:34	2.8008750463	0.3995680346	-0.917371229	890
08/25/89	12:02:34	2.8225312966	0.3930885529	-0.933720367	950
08/25/89	12:03:34	2.844187547	0.3866090713	-0.9503412482	1010
08/25/89	12:04:34	2.8802812976	0.3758099352	-0.9786717549	1070
08/25/89	12:06:34	2.9308125484	0.3606911447	-1.0197332417	1130
08/25/89	12:08:34	2.966906299	0.3498920086	-1.0501307189	1250
08/25/89	12:10:34	2.966906299	0.3498920086	-1.0501307189	1370
08/25/89	12:12:34	3.0390938002	0.3282937365	-1.1138465332	1490
08/25/89	12:14:34	3.0535313004	0.3239740821	-1.12709176	1610
08/25/89	12:16:34	3.0679688007	0.3196544276	-1.1405147803	1730
08/25/89	12:18:34	3.0824063009	0.3153347732	-1.1541204324	1850
08/25/89	12:20:34	3.1040625513	0.3088552916	-1.1748824238	1970
08/25/89	12:22:34	3.1762500524	0.2872570194	-1.2473779259	2090
08/25/89	12:24:34	3.1834688026	0.2850971922	-1.2549251315	2210
08/25/89	12:29:34	3.2845313042	0.2548596112	-1.3670424296	2510
08/25/89	12:34:34	3.3061875546	0.2483801296	-1.3927949257	2810
08/25/89	12:39:34	3.4000313062	0.2203023758	-1.5127542408	3110
08/25/89	12:44:34	3.4433438069	0.2073434125	-1.5733788626	3410
08/25/89	12:49:34	3.4938750577	0.192224622	-1.6490906844	3710
08/25/89	12:54:34	3.5371875584	0.1792656587	-1.7188864463	4010
08/25/89	12:59:34	3.573281309	0.1684665227	-1.7810182274	4310
08/25/89	13:04:34	3.6454688102	0.1468682505	-1.9182193489	4610
08/25/89	13:09:34	3.696000061	0.13174946	-2.0268531899	4910
08/25/89	13:14:34	3.7754063123	0.1079913607	-2.2257040487	5210
08/25/89	13:24:34	3.8475938135	0.0863930886	-2.4488476	5810
08/25/89	13:34:34	3.9125625646	0.0669546436	-2.7037398496	6410
08/25/89	13:44:34	4.0352813166	0.030237581	-3.4986697244	7010
08/25/89	13:54:34	4.1074688178	0.0086393089	-4.7514326932	7610

MW7-1 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/89	08:34:58	7.2620626199			
08/26/89	08:35:00	7.2115313691	0.0143737166		
08/26/89	08:35:02	7.1682188684	0.0266940452		
08/26/89	08:35:04	7.1321251178	0.0369609856		
08/26/89	08:35:06	7.1104688674	0.0431211499		
08/26/89	08:35:08	7.0743751168	0.0533880903		
08/26/89	08:35:10	7.023843866	0.067761807		
08/26/89	08:35:12	6.9516563648	0.0882956879		
08/26/89	08:35:14	6.7928438622	0.1334702259		
08/26/89	08:35:16	6.6051563591	0.1868583162		
08/26/89	08:35:17	6.3669376051	0.2546201232		
08/26/89	08:35:20	5.8255313462	0.40862423		
08/26/89	08:35:22	5.4934688407	0.5030800821		
08/26/89	08:35:24	5.204718836	0.5852156057		
08/26/89	08:35:26	5.0314688331	0.6344969199		
08/26/89	08:35:28	4.8943125808	0.6735112936		
08/26/89	08:35:30	4.7643750787	0.7104722793		
08/26/89	08:35:32	4.663312577	0.7392197125		
08/26/89	08:35:34	4.5694688255	0.7659137577		
08/26/89	08:35:36	4.4684063238	0.794661191		
08/26/89	08:35:41	4.2518438202	0.8562628337		
08/26/89	08:35:46	4.0425000668	0.9158110883		
08/26/89	08:35:51	3.8836875641	0.9609856263		
08/26/89	08:35:56	3.7465313119	1	0	0
08/26/89	08:36:01	4.1146875679	0.8952772074	-0.1106218797	5
08/26/89	08:36:06	4.4539688236	0.7987679671	-0.2246847795	10
08/26/89	08:36:11	4.7282813281	0.7207392197	-0.3274778996	15
08/26/89	08:36:16	4.9592813319	0.6550308008	-0.4230730203	20
08/26/89	08:36:21	5.1686250854	0.5954825462	-0.5183832001	25
08/26/89	08:36:26	5.3635313386	0.5400410678	-0.6161100909	30
08/26/89	08:36:36	5.8544063467	0.4004106776	-0.9152645645	40
08/26/89	08:36:46	6.2586563534	0.2854209446	-1.25379019	50
08/26/89	08:36:56	6.5185313576	0.2114989733	-1.5535351349	60
08/26/89	08:37:06	6.6990001106	0.160164271	-1.8315552964	70
08/26/89	08:37:16	6.8145001125	0.1273100616	-2.0611297381	80
08/26/89	08:37:26	6.901125114	0.1026694045	-2.2762411177	90
08/26/89	08:37:36	6.9588751149	0.0862422998	-2.4505945048	100
08/26/89	08:37:46	7.0021876156	0.0739219712	-2.6047451847	110
08/26/89	08:37:56	7.0310626161	0.0657084189	-2.7225282203	120
08/26/89	08:38:06	7.0671563667	0.0554414784	-2.8924272571	130
08/26/89	08:38:36	7.1176876175	0.0410677618	-3.1925318495	160
08/26/89	08:39:06	7.146562618	0.0328542094	-3.4156754009	190
08/26/89	08:39:36	7.1754376185	0.0246406571	-3.7033574734	220
08/26/89	08:40:06	7.1826563686	0.022587269	-3.7903688504	250
08/26/89	08:40:36	7.1970938689	0.0184804928	-3.9910395458	280
08/26/89	08:41:06	7.204312619	0.0164271047	-4.1088225817	310
08/26/89	08:41:36	7.204312619	0.0164271047	-4.1088225817	340
08/26/89	08:42:06	7.2115313691	0.0143737166	-4.2423539739	370
08/26/89	08:42:36	7.2115313691	0.0143737166	-4.2423539739	400
08/26/89	08:43:06	7.2187501192	0.0123203285	-4.3965046539	430

MW7-1 SLUG TEST DATA

08/26/89	08:44:06	7.2331876194	0.0082135524	-4.8019697617	490
08/26/89	08:45:06	7.2404063696	0.0061601643	-5.0896518345	550
08/26/89	08:46:06	7.2404063696	0.0061601643	-5.0896518345	610
08/26/89	08:47:06	7.2404063696	0.0061601643	-5.0896518345	670
08/26/89	08:48:06	7.2476251197	0.0041067762	-5.4951169433	730
08/26/89	08:49:06	7.2548438698	0.0020533881	-6.1882641228	790

MW7-2 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/80	09:06:43	9.4998751569			
08/26/80	09:06:46	9.4926564068	0.0071942446		
08/26/80	09:06:48	9.4421251559	0.0575539568		
08/26/80	09:06:50	9.4421251559	0.0575539568		
08/26/80	09:06:52	9.4349064058	0.0647482014		
08/26/80	09:06:54	9.4349064058	0.0647482014		
08/26/80	09:06:56	9.4276876557	0.071942446		
08/26/80	09:06:58	9.4060314053	0.0935251798		
08/26/80	09:06:59	9.3915939051	0.1079136691		
08/26/80	09:07:02	9.2544376528	0.2446043165		
08/26/80	09:07:04	9.0306563991	0.4676258993		
08/26/80	09:07:06	8.7419063944	0.7553956835		
08/26/80	09:07:08	8.4964688903	1		
08/26/80	09:07:10	8.4964688903	1	0	0
08/26/80	09:07:12	8.5758751416	0.9208633093	-0.0824436692	2
08/26/80	09:07:14	8.6841563934	0.8129496403	-0.2070861144	4
08/26/80	09:07:16	8.8068751454	0.690647482	-0.3701257417	6
08/26/80	09:07:18	8.8574063963	0.6402877698	-0.4458375634	8
08/26/80	09:07:19	8.8718438965	0.6258992806	-0.4685658145	9
08/26/80	09:07:23	8.7058126438	0.7913669065	-0.2339935673	14
08/26/80	09:07:27	8.5181251407	0.9784172662	-0.0218190474	19
08/26/80	09:07:32	8.9440313977	0.5539568345	-0.5906685113	24
08/26/80	09:07:37	9.1750314015	0.3237410072	-1.1278114434	29
08/26/80	09:07:42	9.2905314034	0.2086330935	-1.5671781031	34
08/26/80	09:07:47	9.3555001545	0.1438848921	-1.9387416595	39
08/26/80	09:07:52	9.3988126552	0.1007194245	-2.2954166034	44
08/26/80	09:07:57	9.4132501555	0.0863309352	-2.4495672834	49
08/26/80	09:08:02	9.4349064058	0.0647482014	-2.737249356	54
08/26/80	09:08:07	9.4421251559	0.0575539568	-2.8550323912	59
08/26/80	09:08:12	9.449343906	0.0503597122	-2.9885637841	64
08/26/80	09:08:22	9.4637814063	0.035971223	-3.3250360205	74
08/26/80	09:08:32	9.4782189065	0.0215827338	-3.8358616449	84
08/26/80	09:08:42	9.4854376567	0.0143884892	-4.2413267533	94
08/26/80	09:08:52	9.4926564068	0.0071942446	-4.9344739329	104
08/26/80	09:09:02	9.4926564068	0.0071942446	-4.9344739329	114
08/26/80	09:09:12	9.4998751569			124
08/26/80	09:09:22	9.4998751569			134
08/26/80	09:09:32	9.4998751569			144
08/26/80	09:09:42	9.507093907			154

MW7-3 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/89	07:36:21	11.261250186			
08/26/89	07:36:22	11.2684689361			
08/26/89	07:36:24	11.2540314358	0.0020833333		
08/26/89	07:36:26	11.2251564354	0.00625		
08/26/89	07:36:28	11.1890626848	0.0114583333		
08/26/89	07:36:30	11.1746251845	0.0135416667		
08/26/89	07:36:32	11.1385314339	0.01875		
08/26/89	07:36:34	11.1096564335	0.0229166667		
08/26/89	07:36:35	11.0880001831	0.0260416667		
08/26/89	07:36:38	11.0374689323	0.0333333333		
08/26/89	07:36:40	11.023031432	0.0354166667		
08/26/89	07:36:42	11.0085939318	0.0375		
08/26/89	07:36:44	10.9941564316	0.0395833333		
08/26/89	07:36:46	10.9652814311	0.04375		
08/26/89	07:36:48	10.9580626809	0.04375		
08/26/89	07:36:50	10.9364064306	0.0479166667		
08/26/89	07:36:52	10.8570001793	0.059375		
08/26/89	07:36:54	10.5754689246	0.1		
08/26/89	07:36:56	10.3444689208	0.1333333333		
08/26/89	07:36:58	10.0051876652	0.1822916667		
08/26/89	07:37:03	8.9801251483	0.3302083333		
08/26/89	07:37:08	7.8179063791	0.4979166667		
08/26/89	07:37:13	6.720656361	0.65625		
08/26/89	07:37:18	5.7172500944	0.8010416667		
08/26/89	07:37:23	4.9448438317	0.9125		
08/26/89	07:37:28	4.3384688216	1	0	0
08/26/89	07:37:33	4.5045000744	0.9760416667	-0.0242500022	5
08/26/89	07:37:38	4.9231875813	0.915625	-0.0881483868	10
08/26/89	07:37:43	5.2263750863	0.871875	-0.137109214	15
08/26/89	07:37:48	5.4212813395	0.84375	-0.1698990368	20
08/26/89	07:37:58	5.753343845	0.7958333333	-0.2283654953	30
08/26/89	07:38:08	6.0709688503	0.75	-0.2876820725	40
08/26/89	07:38:18	6.3669376051	0.7072916667	-0.3463121569	50
08/26/89	07:38:28	6.6484688598	0.6666666667	-0.4054651081	60
08/26/89	07:38:38	6.9227813643	0.6270833333	-0.4666758392	70
08/26/89	07:38:48	7.1682188684	0.5916666667	-0.5248118657	80
08/26/89	07:38:58	7.4064376223	0.5572916667	-0.5846665376	90
08/26/89	07:39:08	7.6157813758	0.5270833333	-0.6403966152	100
08/26/89	07:39:18	7.810687629	0.4989583333	-0.6952326871	110
08/26/89	07:39:28	7.9839376318	0.4739583333	-0.7466358655	120
08/26/89	07:39:58	8.5109063906	0.3979166667	-0.9215126759	150
08/26/89	07:40:28	8.9512501478	0.334375	-1.0954921613	180
08/26/89	07:40:58	9.3049689037	0.2833333333	-1.2611312182	210
08/26/89	07:41:28	9.6153751588	0.2385416667	-1.4332112809	240
08/26/89	07:41:58	9.8752501631	0.2010416667	-1.6042430956	270
08/26/89	07:42:28	10.0918126667	0.1697916667	-1.7731830837	300
08/26/89	07:42:58	10.2722814196	0.14375	-1.9396795993	330
08/26/89	07:43:28	10.4238751721	0.121875	-2.1047593497	360
08/26/89	07:43:58	10.5538126743	0.103125	-2.2718134343	390
08/26/89	07:44:28	10.654875176	0.0885416667	-2.424282028	420

MW7-3 SLUG TEST DATA

08/26/89	07:45:28	10.8209064287	0.0645833333	-2.7397988994	480
08/26/89	07:46:28	10.9291876805	0.0489583333	-3.0167856828	540
08/26/89	07:47:28	11.0085939318	0.0375	-3.283414346	600
08/26/89	07:48:28	11.0591251826	0.0302083333	-3.4996374546	660
08/26/89	07:49:28	11.1024376834	0.0239583333	-3.7314390686	720
08/26/89	07:50:28	11.1313126838	0.0197916667	-3.9224943055	780
08/26/89	07:51:28	11.1529689342	0.0166666667	-4.0943445624	840
08/26/89	07:52:28	11.1674064344	0.0145833333	-4.2278759549	900
08/26/89	07:53:28	11.1818439347	0.0125	-4.3820266348	960
08/26/89	07:54:28	11.1818439347	0.0125	-4.3820266348	1020
08/26/89	07:56:28	11.1890626848	0.0114583333	-4.4690380118	1140
08/26/89	07:58:28	11.1962814349	0.0104166667	-4.5643481916	1260
08/26/89	08:00:28	11.203500185	0.0114583333	-4.4690380118	1380
08/26/89	08:02:28	11.2179376853	0.0072916667	-4.9210231357	1500
08/26/89	08:04:28	11.2107189351	0.0083333333	-4.787491743	1620
08/26/89	08:06:43	11.2251564354	0.00625	-5.0751738153	1740

MW7-4 SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/27/89	08:42:45	7.9550626314			
08/27/89	08:42:47	7.3703438717	0.1325695581		
08/27/89	08:42:49	6.7567501116	0.271685761		
08/27/89	08:42:50	6.417468856	0.348608838		
08/27/89	08:42:53	6.05653135	0.4304418985		
08/27/89	08:42:55	5.7750000954	0.4942716858		
08/27/89	08:42:57	5.3130000877	0.5990180033		
08/27/89	08:42:59	4.8726563305	0.6988543372		
08/27/89	08:43:01	4.4250938231	0.8003273322		
08/27/89	08:43:03	3.9703125656	0.9034369885		
08/27/89	08:43:05	3.5588438088	0.9967266776		
08/27/89	08:43:07	3.5444063085	1	-1.1102230E-16	0
08/27/89	08:43:09	3.5588438088	0.9967266776	-0.0032786915	2
08/27/89	08:43:11	3.63103131	0.9803600655	-0.0198353611	4
08/27/89	08:43:13	3.7320938116	0.9574468085	-0.0434851119	6
08/27/89	08:43:15	3.8042813128	0.9410801964	-0.0607269184	8
08/27/89	08:43:17	3.9053438145	0.9181669394	-0.0853760536	10
08/27/89	08:43:19	3.9847500658	0.9001636661	-0.1051786809	12
08/27/89	08:43:21	4.0713750672	0.8805237316	-0.127238399	14
08/27/89	08:43:23	4.1507813185	0.8625204583	-0.1478964106	16
08/27/89	08:43:28	4.3384688216	0.8199672668	-0.1984908581	21
08/27/89	08:43:33	4.4900625742	0.7855973813	-0.2413108553	26
08/27/89	08:43:38	4.6344375765	0.7528641571	-0.2838704697	31
08/27/89	08:43:43	4.7499375784	0.7266775777	-0.3192723967	36
08/27/89	08:43:48	4.8726563305	0.6988543372	-0.3583129459	41
08/27/89	08:43:53	4.9737188321	0.6759410802	-0.3916493662	46
08/27/89	08:43:58	5.0747813338	0.6530278232	-0.4261355423	51
08/27/89	08:44:03	5.1397500849	0.6382978723	-0.44895022	56
08/27/89	08:44:08	5.1975000858	0.6252045827	-0.4696763506	61
08/27/89	08:44:13	5.2769063371	0.6072013093	-0.4988948966	66
08/27/89	08:44:23	5.45015634	0.5679214403	-0.5657721792	76
08/27/89	08:44:33	5.6450625932	0.5237315876	-0.6467759634	86
08/27/89	08:44:43	5.8327500963	0.4811783961	-0.7315171918	96
08/27/89	08:44:53	5.9987813491	0.4435351882	-0.8129781383	106
08/27/89	08:45:03	6.1575938517	0.4075286416	-0.8976440627	116
08/27/89	08:45:13	6.3019688541	0.3747954173	-0.9813749556	126
08/27/89	08:45:23	6.4319063562	0.3453355155	-1.0632388257	136
08/27/89	08:45:33	6.5546251082	0.317512275	-1.1472388001	146
08/27/89	08:45:43	6.6773438603	0.2896890344	-1.2389472266	156
08/27/89	08:45:53	6.7784063619	0.2667757774	-1.3213467584	166
08/27/89	08:46:23	7.0455001164	0.2062193126	-1.5788150522	196
08/27/89	08:46:53	7.2620626199	0.1571194763	-1.8507487677	226
08/27/89	08:47:23	7.449750123	0.1145662848	-2.1666017172	256
08/27/89	08:47:53	7.5869063753	0.0834697218	-2.4832713265	286
08/27/89	08:48:23	7.7024063772	0.0572831424	-2.8597488978	316
08/27/89	08:48:53	7.7890313786	0.0376432079	-3.2796027433	346
08/27/89	08:49:23	7.8540001297	0.022913257	-3.7760396297	376
08/27/89	08:49:53	7.9045313805	0.0114566285	-4.4691868104	406
08/27/89	08:50:23	7.9478438813	0.0016366612	-6.415096962	436

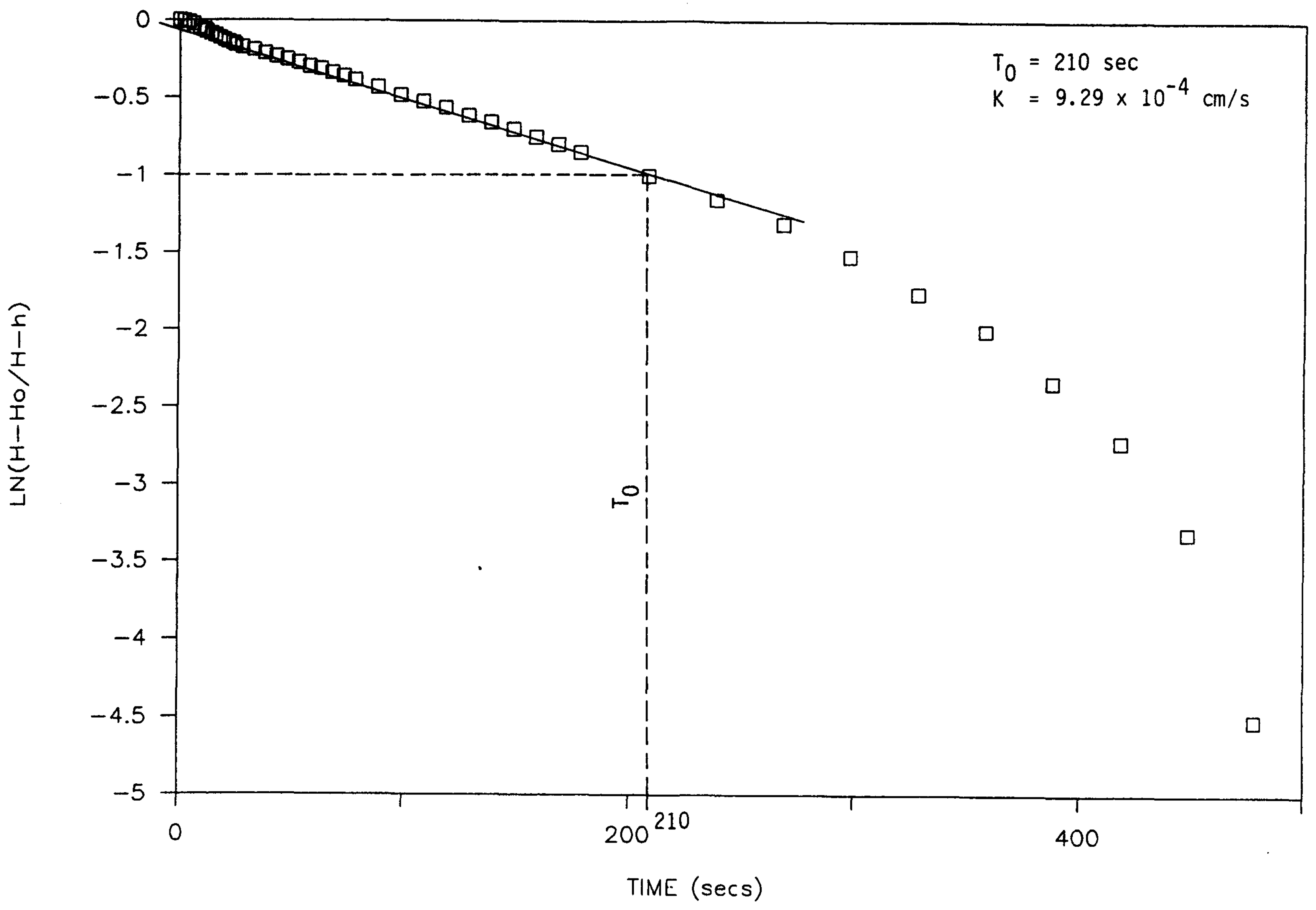
MWBG SLUG TEST DATA

Date	Time	h	H-Ho/H-h	LN(H-Ho/H-h)	Elapsed time (sec)
08/26/89	16:22:12	6.1720313519			
08/26/89	16:22:14	5.8544063467	0.0561941252		
08/26/89	16:22:16	5.4862500906	0.1213282248		
08/26/89	16:22:18	5.1108750844	0.1877394636		
08/26/89	16:22:20	4.7932500792	0.2439335888		
08/26/89	16:22:22	4.4611875737	0.3026819923		
08/26/89	16:22:24	4.179656319	0.3524904215		
08/26/89	16:22:26	3.8981250644	0.4022988506		
08/26/89	16:22:29	3.4866563076	0.4750957854		
08/26/89	16:22:30	3.2412188035	0.5185185185		
08/26/89	16:22:32	3.0463125503	0.5530012771		
08/26/89	16:22:34	2.8369687968	0.5900383142		
08/26/89	16:22:36	2.6276250434	0.6270753512		
08/26/89	16:22:38	2.4543750405	0.6577266922		
08/26/89	16:22:40	2.2522500372	0.69348659		
08/26/89	16:22:42	2.1078750348	0.7190293742		
08/26/89	16:22:44	1.9418437821	0.748403576		
08/26/89	16:22:46	1.7974687797	0.7739463602		
08/26/89	16:22:49	1.5303750253	0.8212005109		
08/26/89	16:22:50	1.4004375231	0.8441890166		
08/26/89	16:22:55	1.0250625169	0.9106002554		
08/26/89	16:23:00	0.5197500086	1	-1.1102230E-16	0
08/26/89	16:23:05	0.8590312642	0.9399744572	-0.0619025773	5
08/26/89	16:23:10	1.3138125217	0.8595146871	-0.1513873663	10
08/26/89	16:23:15	1.6025625265	0.8084291188	-0.2126622738	15
08/26/89	16:23:20	1.7469375288	0.7828863346	-0.2447677601	20
08/26/89	16:23:25	1.8407812804	0.7662835249	-0.2662030408	25
08/26/89	16:23:30	1.9057500315	0.754789272	-0.2813166786	30
08/26/89	16:23:35	1.9562812823	0.7458492976	-0.2932317132	35
08/26/89	16:23:40	2.0140312833	0.7356321839	-0.3070250353	40
08/26/89	16:23:50	2.1006562847	0.7203065134	-0.3280784445	50
08/26/89	16:23:59	2.1656250358	0.7088122605	-0.3441645822	60
08/26/89	16:24:10	2.2233750367	0.6985951469	-0.3586838936	70
08/26/89	16:24:20	2.2666875374	0.6909323116	-0.3697134171	80
08/26/89	16:24:30	2.3100000381	0.6832694764	-0.3808659491	90
08/26/89	16:24:39	2.3388750386	0.6781609195	-0.3883706748	100
08/26/89	16:24:50	2.3749687892	0.6717752235	-0.3978314833	110
08/26/89	16:25:00	2.3966250396	0.6679438059	-0.4035512319	120
08/26/89	16:25:10	2.4110625398	0.6653895275	-0.4073826542	130
08/26/89	16:25:20	2.4327187902	0.6615581098	-0.4131574537	160
08/26/89	16:25:50	2.483250041	0.6526181354	-0.4267631058	190
08/26/89	16:26:20	2.5265625417	0.6449553001	-0.4385742667	220
08/26/89	16:26:50	2.5698750424	0.6372924649	-0.4505266002	250
08/26/89	16:27:19	2.605968793	0.6309067688	-0.4605971788	280
08/26/89	16:27:50	2.634843793	0.625798212	-0.4687273049	310
08/26/89	16:28:20	2.663718794	0.6206896552	-0.4769240721	340
08/26/89	16:28:50	2.6925937945	0.6155810983	-0.4851885819	370
08/26/89	16:29:19	2.7214687949	0.6104725415	-0.4935219635	400
08/26/89	16:29:50	2.7431250453	0.6066411239	-0.499817892	430
08/26/89	16:30:20	2.7647812957	0.6028097063	-0.5061537104	460

MWBG SLUG TEST DATA

08/26/89	16:31:20	2.8008750463	0.5964240102	-0.5168034383	520
08/26/89	16:32:20	2.844187547	0.588761175	-0.529734653	580
08/26/89	16:33:20	2.8802812976	0.5823754789	-0.5406398865	640
08/26/89	16:34:20	2.9235937983	0.5747126437	-0.5538851132	700
08/26/89	16:35:20	2.966906299	0.5670498084	-0.5673081336	760
08/26/89	16:36:20	3.0102187997	0.5593869732	-0.5809137856	820
08/26/89	16:37:20	3.0390938002	0.5542784163	-0.5900881619	880
08/26/89	16:38:20	3.0751875508	0.5478927203	-0.6016757771	940
08/26/89	16:39:20	3.0968438011	0.5440613027	-0.6086933497	1000
08/26/89	16:40:20	3.1401563019	0.5363984674	-0.6228779847	1120
08/26/89	16:42:20	3.212343803	0.5236270754	-0.6469755363	1240
08/26/89	16:44:20	3.2773125541	0.5121328225	-0.6691712687	1360
08/26/89	16:46:20	3.3422813052	0.5006385696	-0.6918708562	1480
08/26/89	16:48:20	3.4216875565	0.4865900383	-0.7203333209	1600
08/26/89	16:50:20	3.4938750577	0.4738186462	-0.7469306334	1720
08/26/89	16:52:20	3.5588438088	0.4623243934	-0.7714884842	1840
08/26/89	16:54:20	3.6093750596	0.4533844189	-0.7910149065	1960
08/26/89	16:56:20	3.6671250606	0.4431673052	-0.813807916	2080
08/26/89	16:58:20	3.7320938116	0.4316730524	-0.8400868005	2200
08/26/89	17:00:20	3.7898438126	0.4214559387	-0.8640400415	2320
08/26/89	17:05:20	3.9486563152	0.3933588761	-0.933032913	2620
08/26/89	17:10:20	4.0930313176	0.367816092	-1.0001722159	2920
08/26/89	17:15:20	4.23740632	0.3422733078	-1.0721457155	3220
08/26/89	17:20:20	4.3673438221	0.319284802	-1.1416717781	3520
08/26/89	17:25:20	4.5045000744	0.2950191571	-1.2207149855	3820
08/26/89	17:30:20	4.6416563266	0.2707535121	-1.3065464213	4120
08/26/89	17:35:20	4.7571563286	0.2503192848	-1.3850180368	4420
08/26/89	17:40:20	4.8798750806	0.2286079183	-1.4757468901	4720
08/26/89	17:45:20	4.9953750825	0.2081736909	-1.5693824952	5020
08/26/89	17:50:20	5.089218834	0.1915708812	-1.6524974019	5320
08/26/89	18:00:20	5.2624688369	0.1609195402	-1.826850789	5620
08/26/89	18:10:20	5.4140625894	0.1340996169	-2.0091723458	6220
08/26/89	18:20:20	5.5512188417	0.1098339719	-2.2087853998	6820
08/26/89	18:30:20	5.6955938441	0.0842911877	-2.473477954	7420
08/26/89	18:40:20	5.7966563457	0.0664112388	-2.7118889774	8020
08/26/89	18:50:20	5.8832813472	0.0510855683	-2.9742532419	8620
08/26/89	19:00:20	5.9699063486	0.0357598978	-3.3309281858	9220
08/26/89	19:10:20	6.0420938498	0.0229885057	-3.7727609381	9820
08/26/89	19:20:20	6.0998438507	0.0127713921	-4.3605476032	10420
08/26/89	19:30:20	6.1575938517	0.0025542784	-5.9699855157	11020

MW 1—1 SLUG TEST



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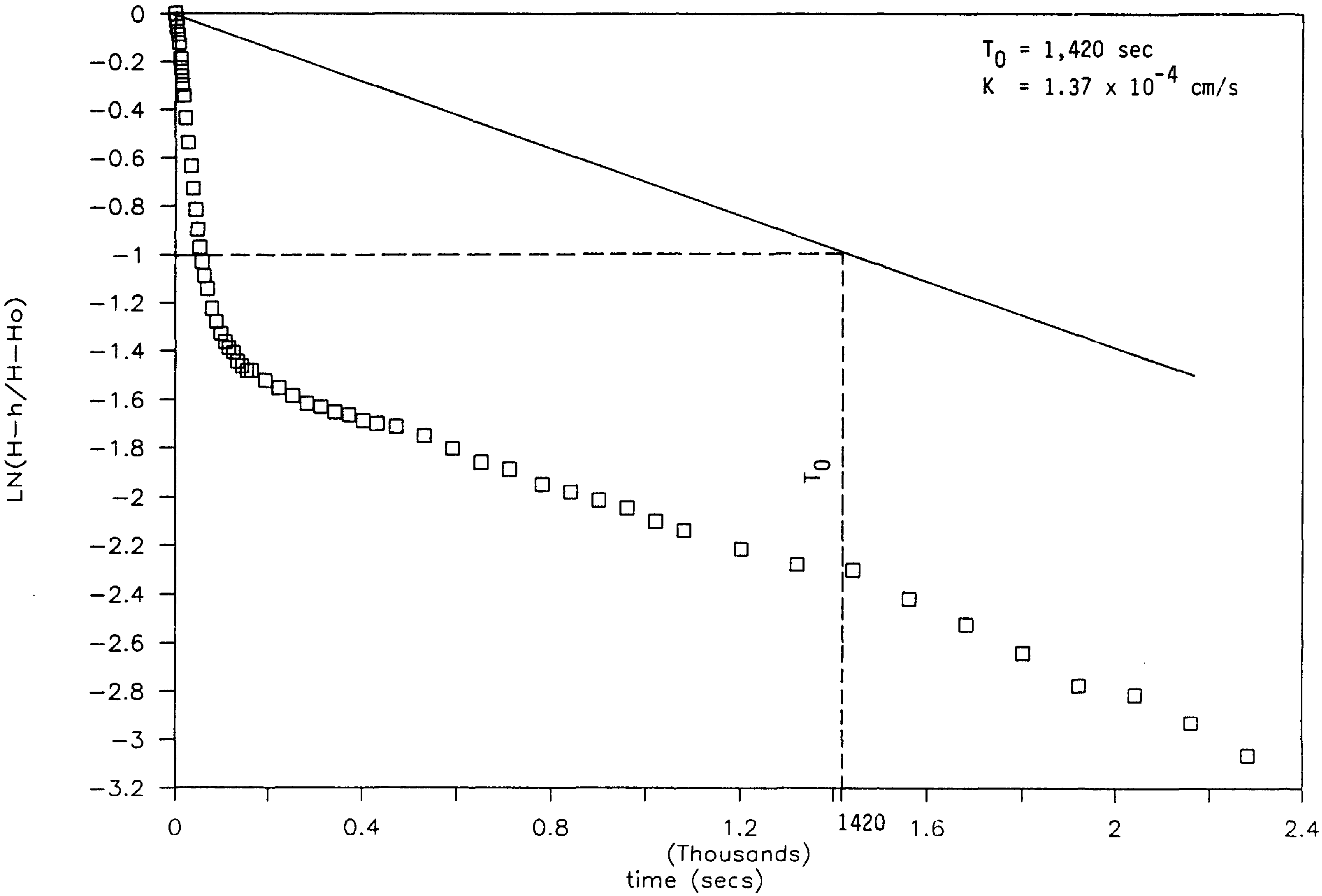

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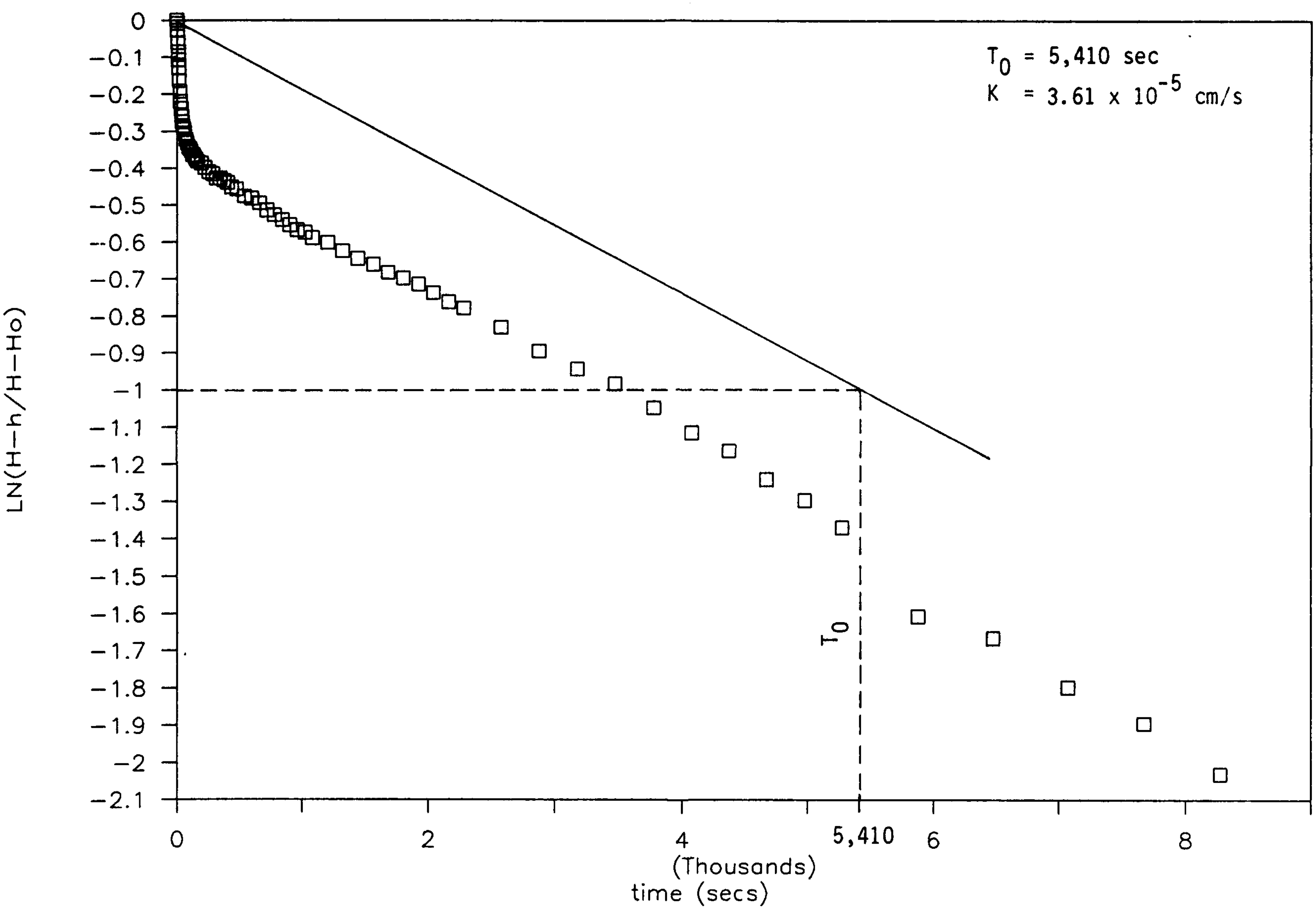
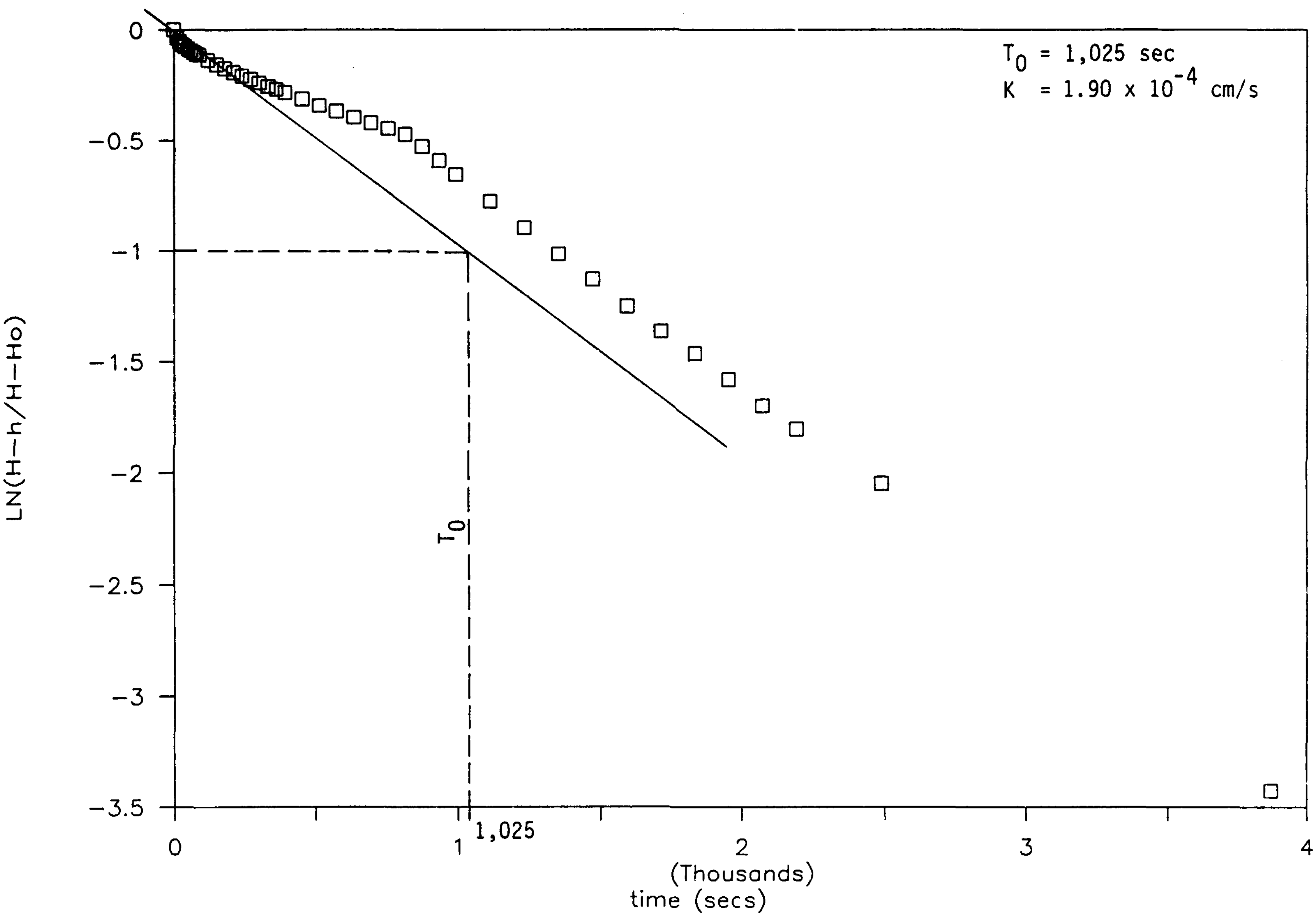


MW2-2 SLUG TEST



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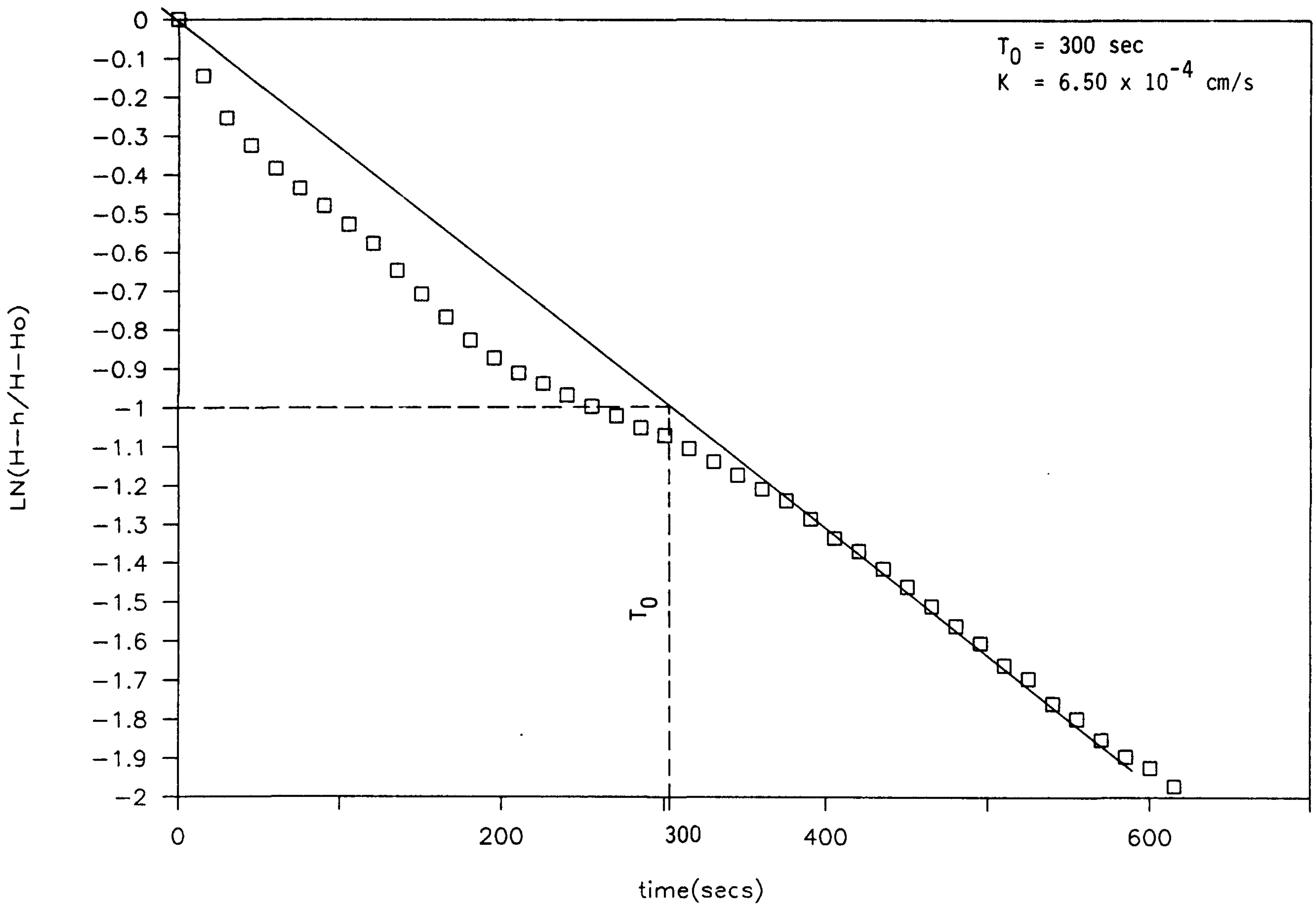
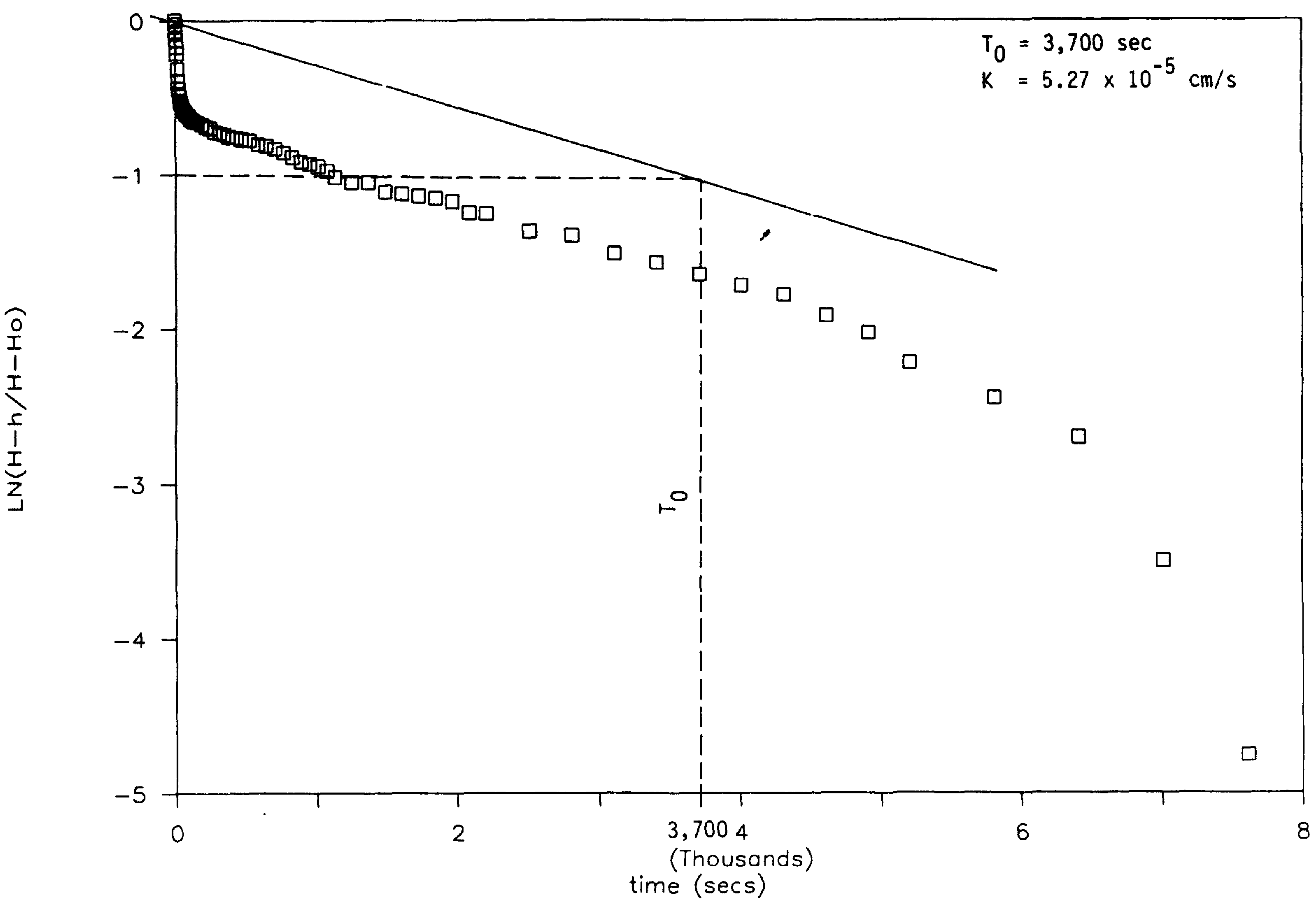
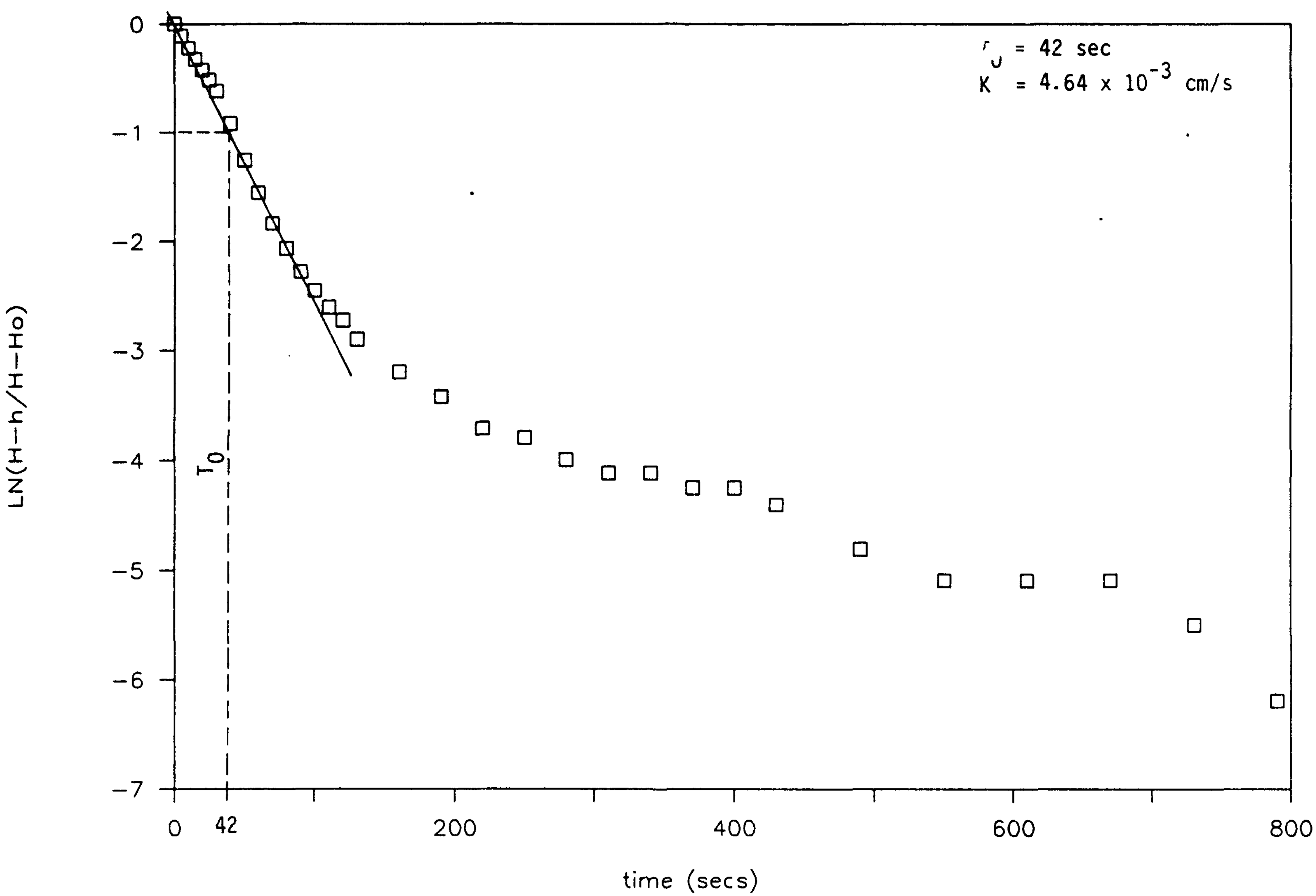


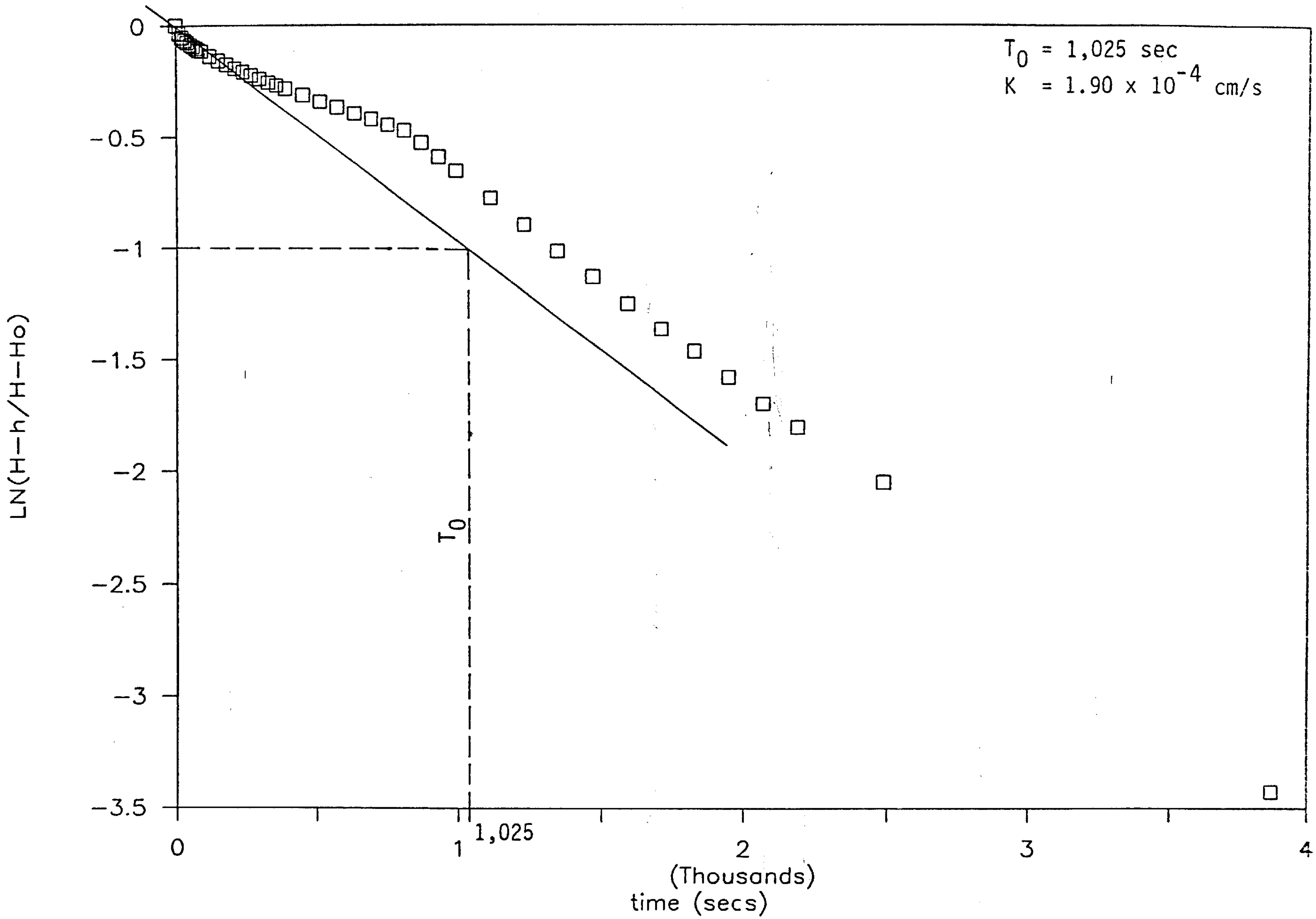
MW5-1 SLUG TEST



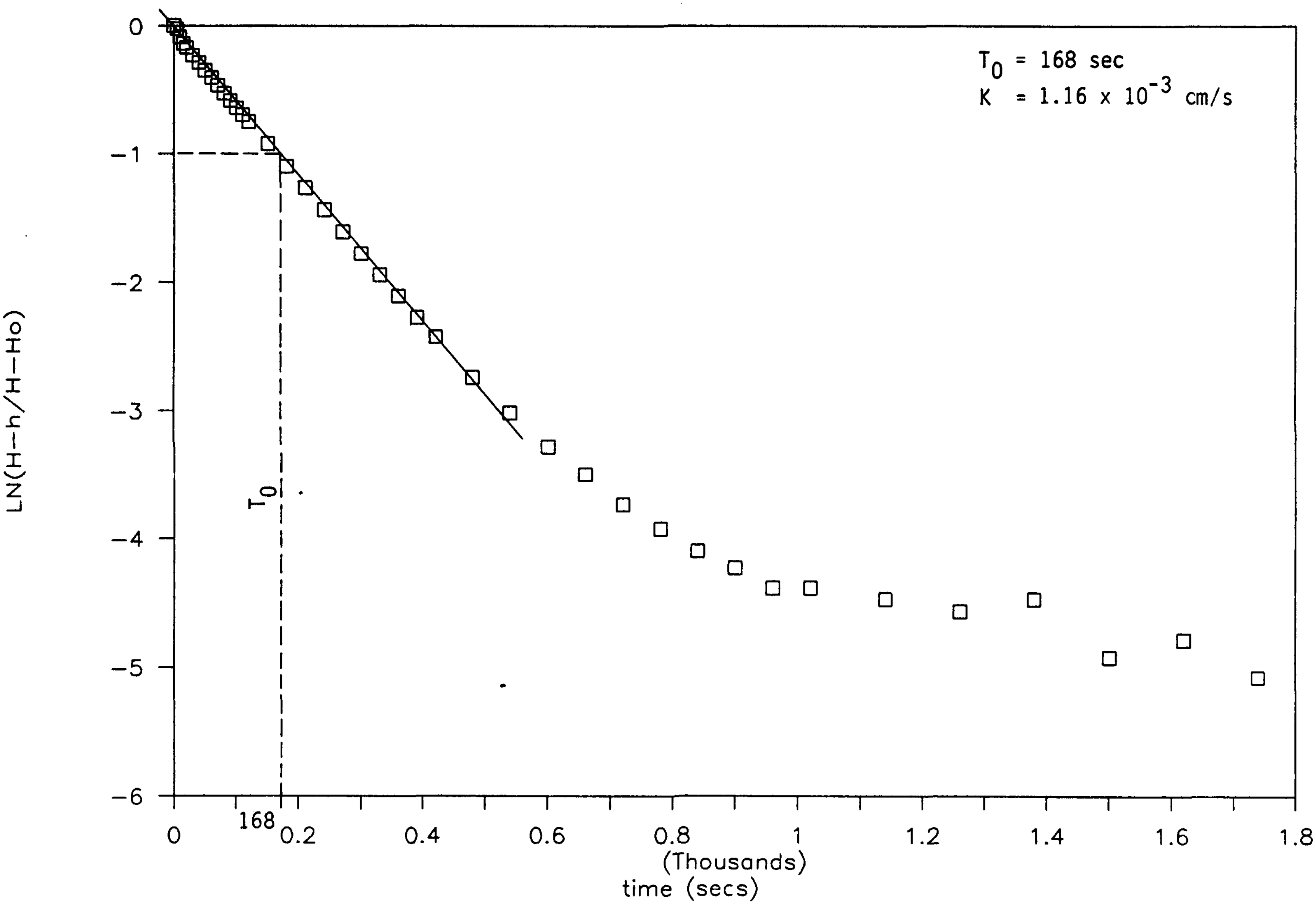
MW7-1 SLUG TEST



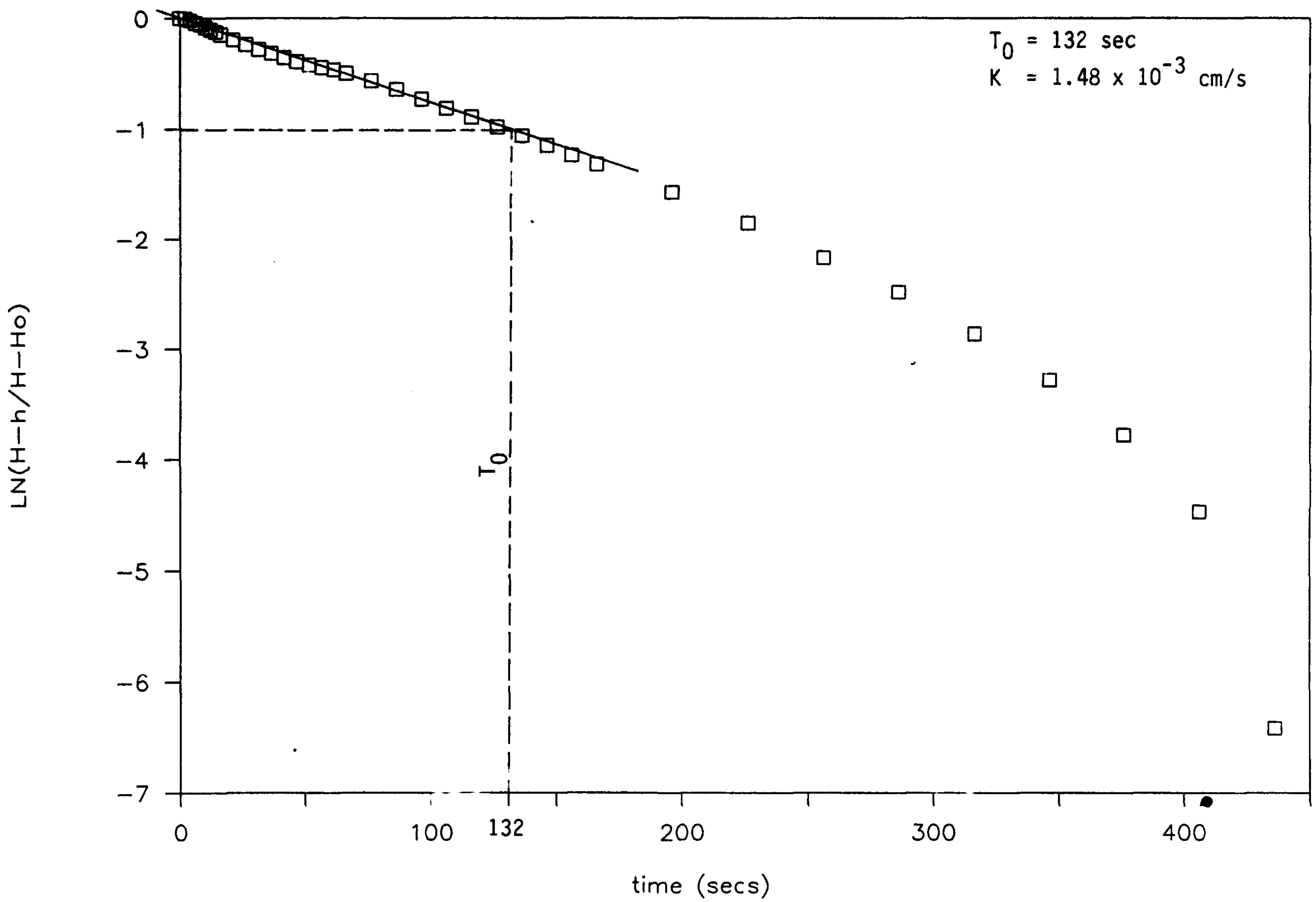
MW2-2 SLUG TEST



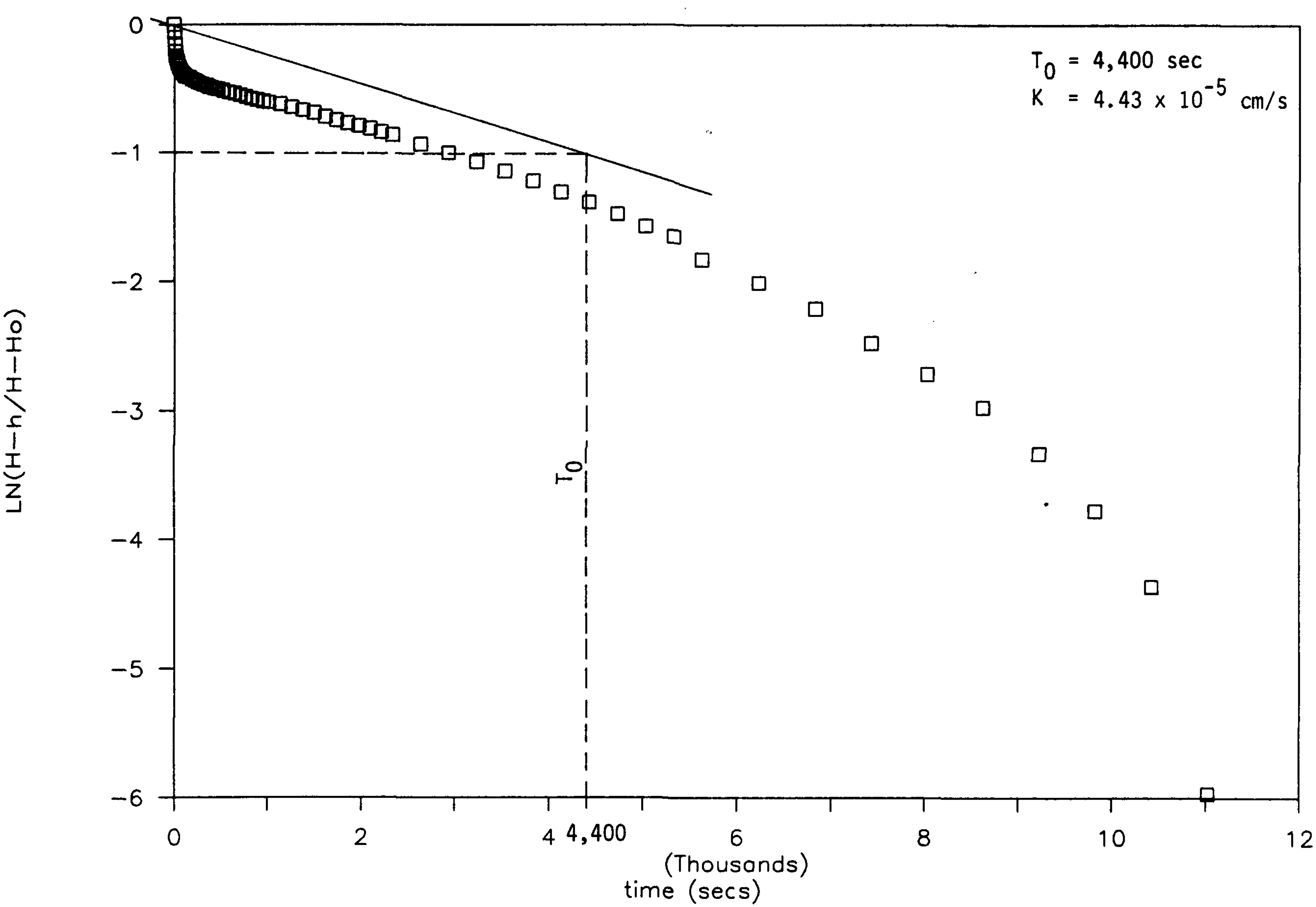
MW7-3 SLUG TEST



MW7–4 SLUG TEST



MWBG SLUG TEST



APPENDIX D

SOIL GAS SURVEY REPORT

Tracer Research Corporation

PREPARED FOR:

Science Applications International Corporation
18706 North Creek Parkway, Suite 110
Bothell, Washington

RECEIVED

OCT 24 1989

BOTHELL
SAIC • ETG

SHALLOW SOIL GAS INVESTIGATION
OREGON AIR NATIONAL GUARD BASE
SITES 2 & 7
PORTLAND, OREGON

SEPTEMBER 1989

SUBMITTED BY:

Mat D. F

Tracer Research Corporation

SAICOANG.MSG
H-139-89-SG

TABLE OF CONTENTS

INTRODUCTION

A shallow soil gas investigation was performed by Tracer Research Corporation (TRC) at the Oregon Air National Guard facility near the Portland International Airport in Portland, Oregon. Soil gas sampling and analyses were performed at Sites 2 and 7 as shown in Figures 1 and 2, respectively. The investigation was conducted on August 15 through 21, 1989 under contract to Science Applications International Corporation (SAIC). The purpose of the investigation was to survey two sites where evidence of contamination by volatile organic compounds (VOCs) is present or suspected. The results will be used to determine possible source areas and to assist in the placement of monitoring wells.

During this survey, a total of fifty-six soil gas stations were sampled and analyzed in the field. Forty-eight stations were sampled at Site 7 and eight stations were sampled at Site 2. Samples were analyzed for volatile compounds from the following suite:

methylene chloride (CH_2CL_2)
bromochloromethane (BCM)
trans-1,2-DCE (trans-1,2-DCE)
carbon tetrachloride (CCL_4)
trichloroethene (TCE)
methyl ethyl ketone (MEK)
benzene
toluene
xylenes
total hydrocarbons

The compounds in this suite were chosen as target compounds based on chemicals believed to have been utilized at the two sites. Methyl ethyl ketone was screened only at Site 2.

Soil gas samples were screened on the electron capture detector (ECD) and flame ionization detector. Analytical results are condensed in Appendix A and reported in micrograms per liter (ug/L). Sampling location maps for Sites 2 and 7 along with isoconcentration contours are in Appendix B.

SHALLOW SOIL GAS INVESTIGATION - METHODOLOGY

Shallow soil gas investigation refers to a method developed by TRC for investigating underground contamination from volatile organic chemicals (VOCs) such as industrial solvents, cleaning fluids and petroleum products by looking for their vapors in the shallow soil gas. The method involves pumping a small amount of soil gas out of the ground through a hollow probe driven into the ground and analyzing the gas for the presence of volatile contaminants. The presence of VOCs in shallow soil gas indicates the observed compounds may either be in the vadose zone near the probe or in groundwater below the probe. The soil gas technology is most effective in mapping low molecular weight halogenated solvent chemicals and petroleum hydrocarbons possessing high vapor pressures and low aqueous solubilities. These compounds readily partition out of the groundwater and into the soil gas as a result of their high gas/liquid partitioning coefficients. Once in the soil gas, VOCs diffuse vertically and horizontally through the soil to the ground surface where they dissipate into the atmosphere. The contamination acts as a source and the above ground atmosphere acts as a sink, and typically a concentration gradient develops between the two. The concentration gradient in soil gas between the source and ground surface may be locally distorted by hydrologic and geologic anomalies (e.g. clays, perched water); however, soil gas mapping generally remains effective because distribution of the contamination is usually broader in areal extent than the local geologic barriers and is defined using a large data base. The presence of geologic obstructions on a small scale tends to create anomalies in the soil gas-groundwater correlation, but generally does not obscure the broader areal picture of the contaminant distribution.

EQUIPMENT

Tracer Research Corporation utilized a one ton Ford analytical field van that was equipped with one gas chromatograph and two Spectra Physics SP4270 computing integrators. In addition, the van has two built-in gasoline powered generators that provide the electrical power (110 volts AC) to operate all of the gas chromatographic instruments and field equipment. A specialized hydraulic mechanism consisting of two cylinders and

a set of jaws was used to drive and withdraw the sampling probes. A hydraulic hammer was used to assist in driving probes past cobbles and through unusually hard soil.

SAMPLING PROCEDURES

Sampling probes consist of 7 to 10-foot lengths of 3/4 inch diameter hollow steel pipe that are fitted with detachable drive points. Soil gas samples were collected by driving the steel probe to a depth of approximately 2-6 feet into the ground. Once inserted into the ground, the above-ground end of the sampling probes were fitted with a steel reducer and a length of polyethylene tubing leading to a vacuum pump. To adequately purge the volume of air within the probe, 2 to 5 liters of gas were evacuated with a vacuum pump. During the soil gas evacuation, samples were collected in a glass syringe by inserting a syringe needle through a silicone rubber segment in the evacuation line and down into the steel probe. Ten milliliters of gas were collected for immediate analysis in the TRC analytical field van. Soil gas was subsampled (duplicate injections) in volumes ranging from 1 uL to 2 mL, depending on the VOC concentration at any particular location.

ANALYTICAL PROCEDURES

A Varian 3300 gas chromatograph, equipped with an electron capture detector (ECD) and a flame ionization detector (FID), was used for the soil gas analyses. The ECD was used for the analyses of CH_2CL_2, BCM, trans-1,2-DCE, CCL_4 and TCE. Compounds were separated on a 6' by 1/8" OD packed column with OV-101 or SP-1000 as the stationary phase. Nitrogen was used as the carrier gas.

Halocarbon compounds detected in soil gas were identified by chromatographic retention time. Quantification of compounds was achieved by comparison of the detector response of the sample with the response measured for calibration standards (external standardization). Instrument calibration checks were run periodically throughout the day and system blanks were run at the beginning of each day to check for contamination in the soil gas sampling equipment. Air samples were also routinely analyzed to check for background levels in the atmosphere.

Because chemical compound identification and quantification was possible in the field, the GC operator was able to examine chromatograms thoroughly so that significant non-target peaks could be identified. This allowed him to make recommendations for adding additional target compounds for subsequent analyses. Non-target peaks were identified and noted on the field data sheets.

Detection limits for the compounds of interest are a function of the injection volume as well as the detector sensitivity for individual compounds. Thus, the detection limit varies with the sample size. Generally, the larger the injection size the greater the sensitivity. However, peaks for compounds of interest must be kept within the linear range of the analytical equipment. If any compound has a high concentration, it is necessary to use small injections, and in some cases to dilute the sample to keep it within linear range. This may cause decreased detection limits for other compounds in the analyses.

The detection limits for the selected compounds ranged as follows; CH_2CL_2 (<0.008 to <0.08 ug/L), BCM (<0.03 to <0.5 ug/L), trans-1,2-DCE (<0.1 to <2 ug/L), CCL_4 (<0.00001 to <0.0001 ug/L), TCE (<0.00008 to <0.0001 ug/L), and approximately <0.01 to <0.3 ug/L for the petroleum hydrocarbons, depending on the conditions of the measurement, in particular, the sample size. If any component being analyzed is not detected, the detection limit for that compound in that analysis is given as a "less than" value (e.g. <0.008 ug/L). Detection limits obtained from GC analyses are calculated from the current response factor, the sample size, and the estimated minimum peak size (area) that would have been visible under the conditions of the measurement.

QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

In addition to following Tracer Research Corporation's normal quality assurance procedures, additional QA/QC procedures were followed as outlined in the statement of work.

- All unknown samples are analyzed at least twice (lab replicates). More unknown samples will be run until reproducibility is within 25% If the difference is greater than 25%, a subsequent sample is run until two

measurements are made that have a difference of 25% or less. Those two measurements will be used in the final calculation for that sample.

. Steel probes are used only once during the day and then washed with high pressure soap and hot water spray or steam-cleaned to eliminate the possibility of cross-contamination. Enough probes are carried on each van to avoid the need to reuse any during the day.

. Probe adaptors (steel reducer and tubing) are used once during the course of the day and cleaned at the end of each working day by baking in the GC oven. The tubing is replaced periodically as needed during the job to insure cleanliness and good fit.

. Silicone tubing (connecting the adaptor to the vacuum pump) is replaced as needed to insure proper sealing around the syringe needle. This tubing does not directly contact soil gas samples.

. Glass syringes are usually used for only one sample per day and are washed and baked out at night. If they must be used twice, they are purged with carrier gas (nitrogen) and baked out between probe samplings.

. Septa through which soil gas samples are injected into the chromatograph are replaced on a daily basis to prevent possible gas leaks from the chromatographic column.

. Analytical instruments were calibrated each day by analytical standards from Chem Service, Inc. The standard is analyzed at least 3 times at the start of each day to determine the mean response factor (RF) for each component. The standard is injected again after every fifth sample to check detector response and chromatographic performance of the instrument throughout the day. The RF allows conversion of peak areas into concentrations for the contaminants of interest. The RF used is changed if the standard response varies 25%. If the standard injections vary by more than 25% the standard injections are repeated. If the mean of the two standard injections represents greater than 25% difference then a third standard is injected and a new RF

is calculated from the three standard injections. A new data sheet is started with the new RF's and calibration data.

. Method blanks (N_2 Blk) are run to check subsampling syringes for contamination prior to sampling each day by injecting nitrogen carrier gas into the gas chromatograph.

. Prior to sampling each day, system blanks (Sys Blk) are run to check the sampling apparatus (probe, adaptor, 10 cc syringe) for contamination by drawing ambient air from above ground through the system and comparing the analysis to a concurrently sampled air analysis.

. All sampling and 2 cc subsampling syringes are decontaminated each day and no such equipment is reused before being decontaminated. Microliter size subsampling syringes are reused only after a nitrogen carrier gas blank is run to insure it is not contaminated by the previous sample.

. Soil gas pumping is monitored by a vacuum gauge to insure that an adequate gas flow from the vadose zone is maintained. A reliable gas sample can be obtained if the negative pressure reading on the vacuum gauge is at least 2 inches Hg less than the maximum pressure of the pump.

. Field duplicates are performed by collecting two soil gas samples at the same sample station and analyzing each sample. Field duplicates were taken at stations SG2-1, SG2-5, and SG7-37.

Data Outside Control Limits

The above procedures were followed during the course of the investigation in order to prevent any cross-contamination of soil gas samples and to assure the quality of the sampling and analytical systems. Several samples collected during the investigation were outside control limits as outlined in the above procedures, specifically in regards to replication of sample analyses. A total of eight samples had analyses outside the 25% replicate limit. In most cases, additional analysis was not warranted because the compounds of concern were below the level of significance. It was deemed unnecessary to

further analyze samples where total hydrocarbon replicate analyses were outside acceptable limits because concentrations were of low significance.

Samples that were not within control limits as outlined in the above QA/QC procedures are noted in the following paragraphs.

8-15-89

Samples collected and analyzed at stations SG2-1 and SG2-4 were outside replicate limits of 25% for total hydrocarbons. These samples were 5 to 10% outside replicate limits.

8-16-89

Samples collected and analyzed at stations SG7-8, SG7-9, and SG7-11 were outside replicate limits of 25% for total hydrocarbons and TCE. Sample SG7-8 was 5% outside replicate limits for total hydrocarbons. Samples SG7-9 and SG7-11 were 10% outside replicate limits for TCE.

8-18-89

Sample SG7-15 was 3% outside replicate limits of 25% for total hydrocarbons.

8-21-89

Sample SG7-45 was 24% outside replicate limits for TCE. Sample SG7-46 was 15% outside replicate limits for toluene. In addition, standard runs for TCE after every five samples were approximately 8% outside replicate limits.

RESULTS

Two sites were investigated during this survey at the Oregon National Guard (ANG) facility; Sites 2 and 7. Elevated concentrations of the selected target VOCs were detected in the soil gas on both Sites 2 and 7. Site 2 is located east of Building 1109 near a former solvent storage shed. Site 7 is a former burn pit that is located on the ANG boundary to the northeast. A total of fifty-seven soil gas samples nine ambient air samples were collected and analyzed in the field. Analytical data is condensed in Appendix A and reported in micrograms per liter. Maps showing the distribution of the several target VOCs are attached in Appendix B.

Ambient air samples were collected during the course of the investigation to help evaluate the level of significance for the selected VOCs. The level of significance is simply the level above which is considered to be significant in terms of groundwater and/or soil contamination. Of the target compounds, only low levels of CCL_4 and TCE were detected in ambient air. Low levels of C_4-C_9 hydrocarbons were also detected in two air samples. The remaining target compounds were not detected. The level of significance for each target compound is based on several factors; concentrations in ambient air, soil gas background levels, and TRC's past experience. Based on the evaluation of these factors, the level of significance for the halogenated compounds was determined to be approximately 0.01 ug/L. The level of significance for the petroleum compounds is approximately 0.1 ug/L. In other words, soil gas concentrations greater than the compound significance level may indicate possible VOC contamination in the vicinity.

Site 2 - Civil Engineering Hazardous Materials Area

The survey was initiated at Site 2 where a solvent storage area formerly existed. A total of eight soil gas samples were collected in the vicinity at intervals of 15 to 25 feet in order to determine directions of increasing and decreasing concentrations. Of the nine target compounds only TCE was detected in the soil gas. Total hydrocarbons were also measured in the soil gas. The highest TCE concentration was detected at sampling location SG2-8 (32 ug/L). Concentrations ranged from 0.003 to 32 ug/L. Total hydrocarbons were

measured at low levels ranging from 0.4 to 6 ug/L.

The subsurface distribution of TCE at Site 2 is depicted in Figure 3. Concentrations are highest at sampling locations SG2-7 (22 ug/L) and SG2-8 (32 ug/L). Concentrations decrease gradually to the north with the exception of sampling location SG2-2 (6 ug/L). The elevated levels detected at sampling location SG2-2 to the north and sampling locations SG2-7 and SG2-8 may indicate the presence of sources in the area.

Site 7 - Burn Pit Area

Prior to sampling at Site 7, a sampling grid was designed to provide adequate coverage of the former burn pit area. Sampling locations were placed at 30 to 70 foot intervals over the entire site. Several target compounds were detected in the area including; methylene chloride, bromochloromethane, TCE, benzene, toluene and xylenes. However, it is the measurement of total hydrocarbons that best defines the soil gas contaminant plume.

Total hydrocarbons range in concentration from 0.2 ug/L at sampling location SG7-4 to 1100 ug/L at sampling location SG7-22. The soil gas plume (Figure 4) is defined by order of magnitude changes in concentration, from 0.1 to 1000 ug/L. Plume boundaries and the extent of contamination are defined by the 1 ug/L isoconcentration contours. The extent of contamination is fairly well defined except to the northwest near sampling location SG7-38 and on the north end of the site near sampling location SG7-41, where further sampling is necessary to delineate the extent of contamination.

The remaining target compounds detected in significant concentrations on-site were as follows; methylene chloride: SG7-41 (4 ug/L) and SG7-42 (2 ug/L), bromochloromethane: SG7-1 (0.6 ug/L), SG7-2 (0.1 ug/L), SG7-4 (0.04 ug/L) and SG7-5 (0.2 ug/L), and TCE: SG7-15 (0.04 ug/L) and SG7-22 (0.2 ug/L). The three petroleum compounds were also detected and had the following range of concentrations; benzene (0.1 - 5 ug/L), toluene (0.1 - 36 ug/L), and xylenes (0.6 - 8 ug/L).

CONCLUSIONS

Significant concentrations of several target compounds were detected on both Sites 2 and 7 located at the Oregon Air National Guard facility. TCE and total hydrocarbons were the only compounds detected at Site 2. The distribution of TCE at Site 2 indicates possible source areas to the north and south. Site 7 has a clearly defined plume of hydrocarbons with concentrations that range over several orders of magnitude and cover the central portion of the site. Other compounds, including; methylene chloride, bromochloromethane, TCE, benzene, toluene, and xylenes, were detected within the confines of the hydrocarbon plume.

Based on these survey results, it is clear that both Sites 2 and 7 have potentially contaminated soil and/or groundwater. Further soil gas investigation at Site 2 would be useful in determining the potential source of elevated levels of TCE to the north and south. Since the hydrocarbon plume at Site 7 is fairly well delineated, TRC recommends confirmation with more conventional methods (i.e. soil borings or monitoring wells).

APPENDIX A: CONDENSED DATA

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-SG
08/15/89
CONDENSED DATA

Sample	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	MEK (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
Air	<0.008	<0.05	<0.2	<0.00001	<0.0001	<0.02	<0.02	<0.01	<0.01	0.7
SG2-1-4'	<0.008	<0.05	<0.2	0.0002	0.004	<0.02	<0.02	<0.01	<0.01	0.8
SG2-3-4'	<0.008	<0.05	<0.2	0.0003	0.006	<0.02	<0.02	<0.01	<0.01	2
SG2-5-4'	<0.008	<0.05	<0.2	0.0002	0.003	<0.02	<0.02	<0.01	<0.01	0.8
SG2-7-4'	<0.008	<0.05	<0.2	0.0007	22	<0.02	<0.02	<0.01	<0.01	2
SG2-8-4'	<0.08	<0.5	<2	<0.0001	32	<0.02	<0.02	<0.01	<0.01	2
SG2-6-4'	<0.08	<0.5	<2	<0.0001	0.4	<0.02	<0.02	<0.01	<0.01	0.4
SG2-4-4'	<0.008	<0.05	<0.2	0.0003	0.02	<0.02	<0.02	<0.01	<0.01	0.4
SG2-2-4'	<0.008	<0.05	<0.2	0.0003	6	<0.02	<0.02	<0.01	<0.01	6
Air	<0.008	<0.05	<0.2	0.0002	0.005	<0.02	<0.02	<0.01	<0.01	0.5

Analyzed by: E. Aamodt
Checked by: J. Olexa
Proofed by: S. Zaplander

Tracer Research Corporation

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-SG
08/16/89
CONDENSED DATA

Sample	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
Air	<0.008	<0.03	<0.2	0.0004	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-1-4'	<0.008	0.6	<0.2	0.0004	0.002	<0.03	<0.03	<0.03	0.7
SG7-2-3'	<0.008	0.1	<0.2	0.0004	0.004	<0.03	<0.03	<0.03	12
SG7-3-3'	<0.008	<0.03	<0.2	0.0002	0.001	<0.06	<0.03	<0.03	5
SG7-4-4'	<0.008	0.04	<0.2	0.00006	0.0007	<0.03	<0.03	<0.03	0.2
SG7-5-3'	<0.008	0.2	<0.2	0.0002	0.002	<0.03	<0.03	<0.03	<0.03
SG7-6-4'	<0.008	<0.03	<0.2	0.0002	0.0008	<0.03	<0.03	<0.03	<0.03
SG7-7-3'	<0.008	<0.03	<0.2	0.0002	0.001	<0.03	<0.03	<0.03	100
SG7-8-3'	<0.008	<0.03	<0.2	0.0002	0.0008	<0.03	<0.03	<0.03	240
SG7-9-3'	<0.008	<0.03	<0.2	0.0001	0.0004	<0.06	<0.06	<0.06	130
SG7-10-3'	<0.008	<0.03	<0.2	0.0001	0.0007	<0.06	<0.06	<0.06	22
SG7-11-4'	<0.008	<0.03	<0.2	0.0002	0.0004	<0.06	2	<0.06	6
SG7-12-4'	<0.008	<0.03	<0.2	0.0001	<0.00008	<0.03	<0.03	<0.03	<0.03

Analyzed by: E. Aamodt
Checked by: J. Olexa
Proofed by: L. Kaplander

Tracer Research Corporation

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-SG
08/18/89
CONDENSED DATA

Sample	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
Air	<0.01	<0.05	<0.1	0.0004	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-12-5'	<0.01	<0.05	<0.1	0.00006	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-13-5'	<0.01	<0.05	<0.1	0.00004	0.0002	<0.03	<0.03	<0.03	<0.03
SG7-14-4'	<0.01	<0.05	<0.1	0.00007	0.0008	<0.03	<0.03	<0.03	290
SG7-15-5'	<0.01	<0.05	<0.1	0.0002	0.04	<0.3	<0.3	<0.3	410
SG7-16-5'	<0.01	<0.05	<0.1	0.00004	0.0004	<0.3	<0.3	<0.3	370
SG7-17-5'	<0.01	<0.05	<0.1	0.00003	<0.00004	<0.3	<0.3	<0.3	4
SG7-18-5'	<0.01	<0.05	<0.1	0.00002	<0.00004	<0.03	<0.03	<0.03	<0.03
SG7-19-5'	<0.01	<0.05	<0.1	0.0002	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-20-5'	<0.01	<0.05	<0.1	0.00003	0.0008	<0.06	<0.06	4	410
SG7-21-5'	<0.01	<0.05	<0.1	0.0001	0.007	<0.6	<0.6	<0.6	560
SG7-22-5'	<0.06	<0.2	<0.5	0.0002	0.2	<6	<6	8	1100
SG7-23-5'	<0.01	<0.05	<0.1	0.00006	0.0001	<0.06	<0.06	<0.06	40
SG7-24-5'	<0.01	<0.05	<0.1	0.00003	<0.00008	<0.06	<0.06	<0.06	0.3
SG7-25-5'	<0.01	<0.05	<0.1	0.0002	<0.00008	<0.06	<0.06	<0.06	<0.06
SG7-26-5'	<0.01	<0.05	<0.1	<0.00002	<0.00008	<0.06	<0.06	<0.06	<0.06
SG7-27-5'	<0.01	<0.05	<0.1	0.00006	<0.00008	<0.06	<0.06	<0.06	<0.06

Analyzed by: E. Aamodt
Checked by: J. Olexa
Proofed by: J. Kaplanda

Tracer Research Corporation

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-SB
08/19/89
CONDENSED DATA

Sample	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
Air	<0.01	<0.05	<0.1	0.0004	0.0006	<0.03	<0.03	<0.03	<0.03
SG7-28-5'	<0.01	<0.05	<0.1	0.00003	0.0006	<0.03	<0.03	<0.03	2
SG7-29-5'	<0.01	<0.05	<0.1	0.00004	0.0002	<0.03	<0.03	<0.03	<0.03
SG7-30-5'	<0.01	<0.05	<0.1	0.00005	0.0002	<0.03	<0.03	<0.03	<0.03
SG7-31-5'	<0.01	<0.05	<0.1	0.00006	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-32-4'	<0.01	<0.05	<0.1	0.00005	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-33-5'	<0.01	<0.05	<0.1	0.00002	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-34-5'	<0.01	<0.05	<0.1	0.00004	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-35-5'	<0.01	<0.05	<0.1	0.00003	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-36-5'	<0.01	<0.05	<0.1	0.00007	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-37-5'	<0.01	<0.05	<0.1	0.00003	<0.00008	<0.03	<0.03	<0.03	<0.03
SG7-38-4'	<0.01	<0.05	<0.1	0.00004	0.0007	<0.03	<0.03	<0.03	540
SG7-39-4'	<0.01	<0.05	<0.1	0.00003	0.0005	<0.03	<0.03	<0.03	9
Air	<0.01	<0.05	<0.1	0.0003	<0.00008	<0.03	<0.03	<0.03	<0.03

Analyzed by: E. Aamodt
Checked by: J. Olexa
Proofed by: S. Gaplazdie

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-SG
08/21/89
CONDENSED DATA

Sample	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
Air	<0.02	<0.08	<0.1	0.0009	<0.0001	<0.09	<0.09	<0.07	<0.2
SG7-40-5'	<0.02	<0.08	<0.1	0.00004	<0.0001	<0.09	<0.09	<0.07	<0.2
SG7-41-5'	4	<0.08	<0.1	0.00004	<0.0001	<0.09	3	<0.07	12
SG7-42-4'	2	<0.08	<0.1	0.00004	0.004	<0.09	4	0.6	22
SG7-43-5'	<0.02	<0.08	<0.1	0.00004	<0.0001	<0.09	<0.09	<0.07	<0.2
SG7-44-5'	<0.02	<0.08	<0.1	0.0006	<0.0001	0.1	0.1	<0.07	0.7
Air	<0.02	<0.08	<0.1	0.0008	<0.0001	<0.09	<0.09	<0.07	<0.2
SG7-45-4'	<0.02	<0.08	<0.1	0.00004	0.005	<0.09	6	0.6	47
SG7-46-5'	<0.02	<0.08	<0.1	0.00004	0.0002	5	36	3	210
SG7-47-3'	<0.02	<0.08	<0.1	0.0004	<0.0001	0.9	24	2	100
SG7-48-5'	<0.02	<0.08	<0.1	0.00004	<0.0001	<0.09	<0.09	<0.07	<0.2
Air	<0.02	<0.08	<0.1	0.0008	<0.0001	<0.09	<0.09	<0.07	<0.2

Analyzed by: E. Aamodt
Checked by: J. Olexa
Proofed by: L. Saplaxder

SAIC/OREGON ANG/PORTLAND, OREGON JOB#H-139-89-56
QA/QC Analyses

Sample	Date	CH2Cl2 (ug/l)	BCM (ug/l)	Trans 1,2 DCE (ug/l)	CCl4 (ug/l)	TCE (ug/l)	MEK (ug/l)	Benzene (ug/l)	Toluene (ug/l)	Xylenes (ug/l)	Total Hydroc. (ug/l)
N2	08/15	<0.004	<0.02	<0.1	<0.00001	<0.00007	<0.02	<0.02	<0.01	<0.01	<0.008
Sys.Blk.	08/15	<0.008	<0.05	<0.2	<0.00001	<0.0001	<0.02	<0.02	<0.01	<0.01	0.6
Air	08/15	<0.008	<0.05	<0.2	<0.00001	<0.001	<0.02	<0.02	<0.01	<0.01	0.7
Air	08/15	<0.008	<0.05	<0.2	0.0002	0.005	<0.02	<0.02	<0.01	<0.01	0.5
N2	08/16	<0.008	<0.03	<0.2	<0.0004	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
Sys.Blk.	08/16	<0.008	<0.03	<0.2	0.0004	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
Air	08/16	<0.008	<0.03	<0.2	0.0004	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
N2	08/18	<0.006	<0.02	<0.05	<0.00001	<0.00004	N/A	<0.03	<0.03	<0.03	<0.03
Sys.Blk.	08/18	<0.01	<0.05	<0.1	0.0004	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
Air	08/18	<0.01	<0.05	<0.1	0.0004	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
N2	08/19	<0.005	<0.02	<0.05	<0.00001	<0.00004	N/A	<0.03	<0.03	<0.03	<0.03
Sys.Blk.	08/19	<0.01	<0.05	<0.1	0.0004	0.0004	N/A	<0.03	<0.03	<0.03	<0.03
Air	08/19	<0.01	<0.05	<0.1	0.0004	0.0006	N/A	<0.03	<0.03	<0.03	<0.03
Air	08/19	<0.01	<0.05	<0.1	0.0003	<0.00008	N/A	<0.03	<0.03	<0.03	<0.03
N2	08/21	<0.02	<0.08	<0.1	<0.00002	<0.0001	N/A	<0.09	<0.09	<0.07	<0.2
Sys.Blk.	08/21	<0.02	<0.08	<0.1	0.0007	<0.0001	N/A	<0.09	<0.09	<0.07	<0.2
Air	08/21	<0.02	<0.08	<0.1	0.0009	<0.0001	N/A	<0.09	<0.09	<0.07	<0.2
Air	08/21	<0.02	<0.08	<0.1	0.0008	<0.0001	N/A	<0.09	<0.09	<0.07	<0.2
Air	08/21	<0.02	<0.08	<0.1	0.0008	<0.0001	N/A	<0.09	<0.09	<0.07	<0.2

N2 - Method blank or syringe blank
Sys.Blk. - System Blank
Air - Ambient air sample
N/A - Not analyzed

Analyzed by: E. Ramodt
Checked by: J. Olexa
Proofed by: L. Laplander

Tracer Research Corporation

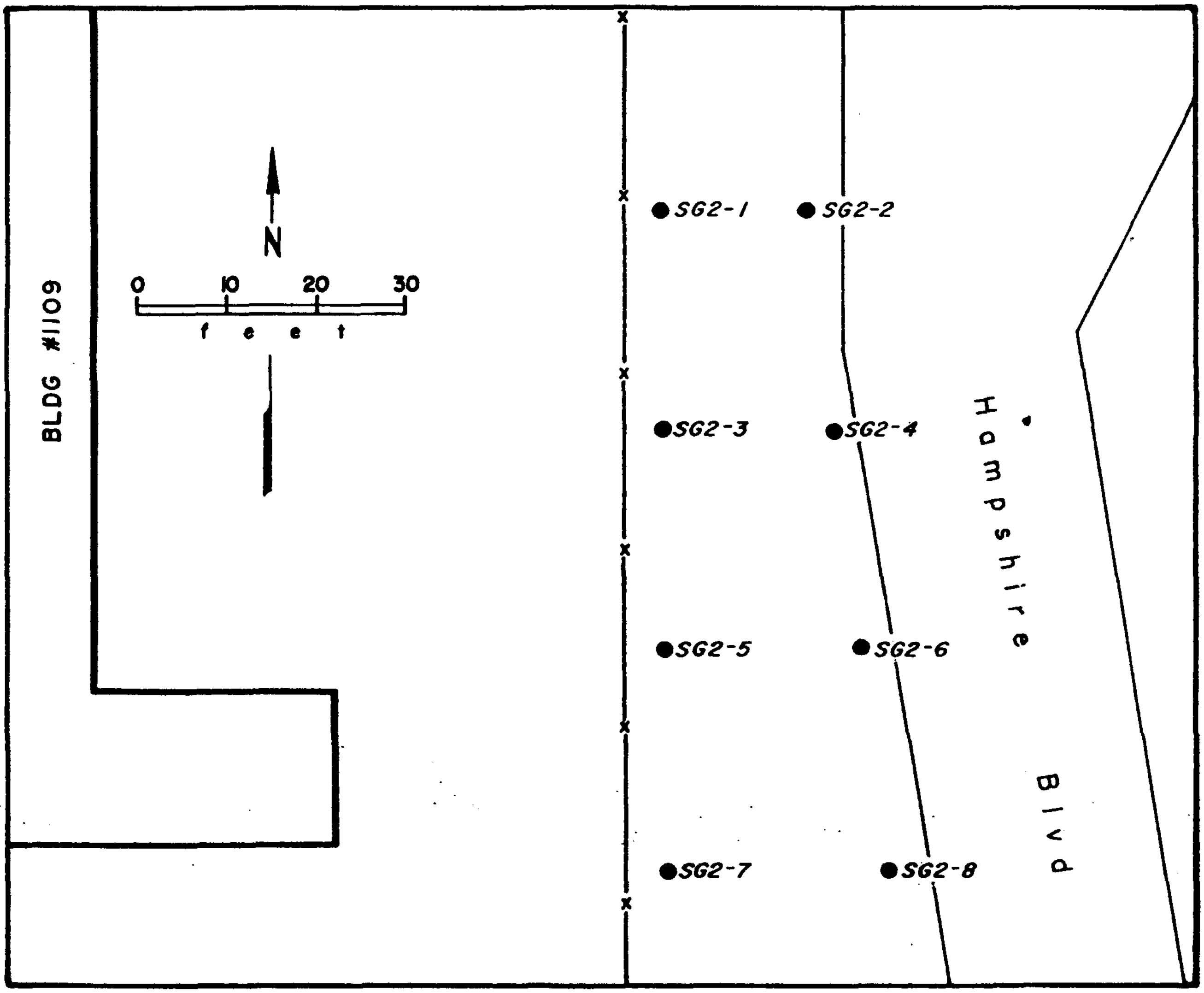
APPENDIX B: MAPS

OREGON AIR NATIONAL GUARD
SITE No. 2 CIVIL ENGINEERING
HAZARDOUS MATERIALS AREA
PORTLAND, OREGON

SAMPLING LOCATIONS

SEPTEMBER 1989

FIGURE 1



EXPLANATION

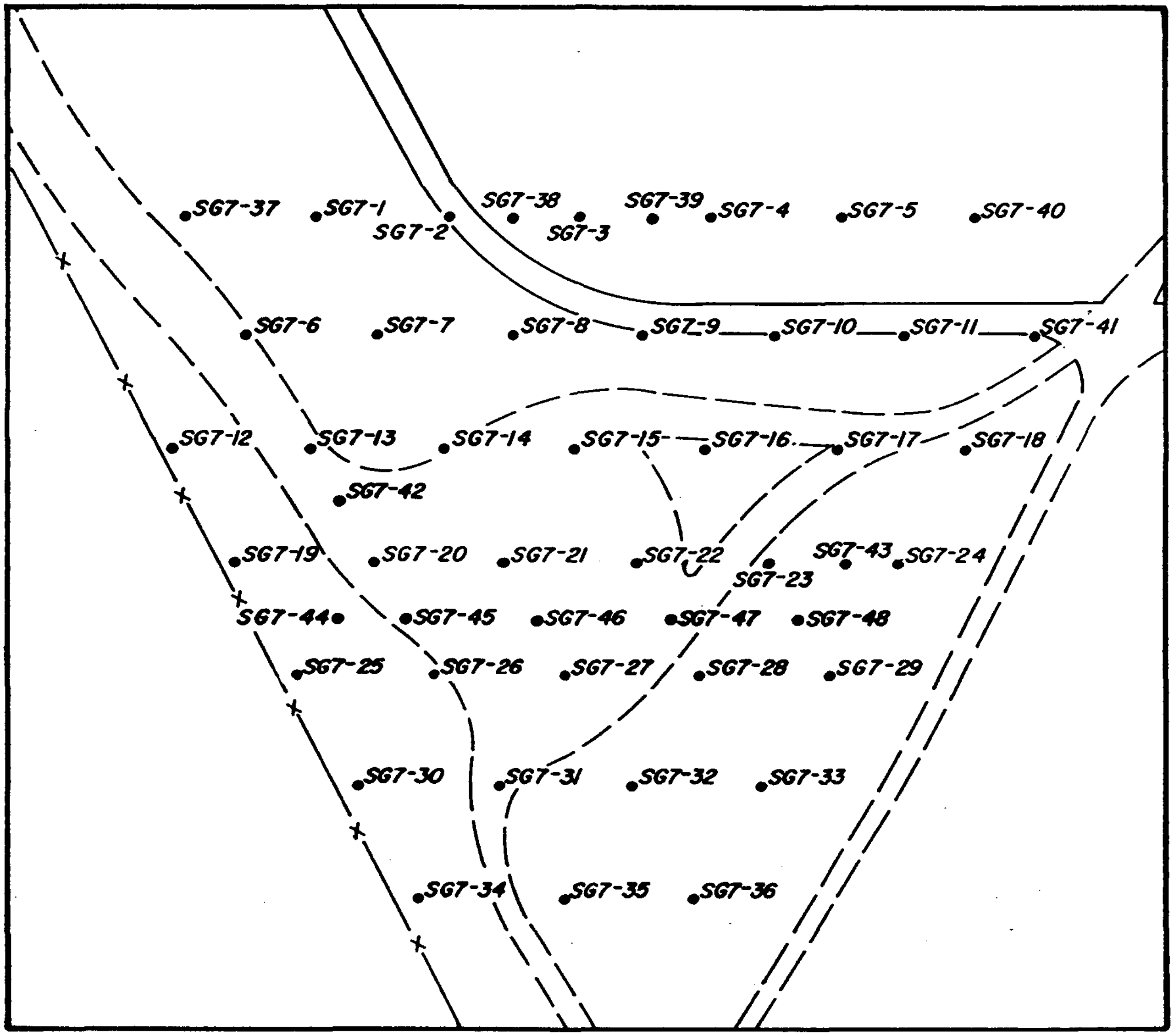
● SG2-1 SITE #2 SOIL GAS SAMPLING LOCATION

OREGON AIR NATIONAL GUARD
SITE No. 7 BURN PIT AREA
PORTLAND, OREGON

SAMPLING LOCATIONS

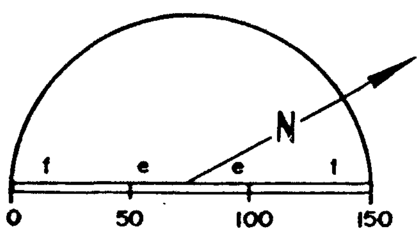
SEPTEMBER 1989

FIGURE 2



EXPLANATION

● SG7-1 SITE #7 SOIL GAS SAMPLING LOCATION

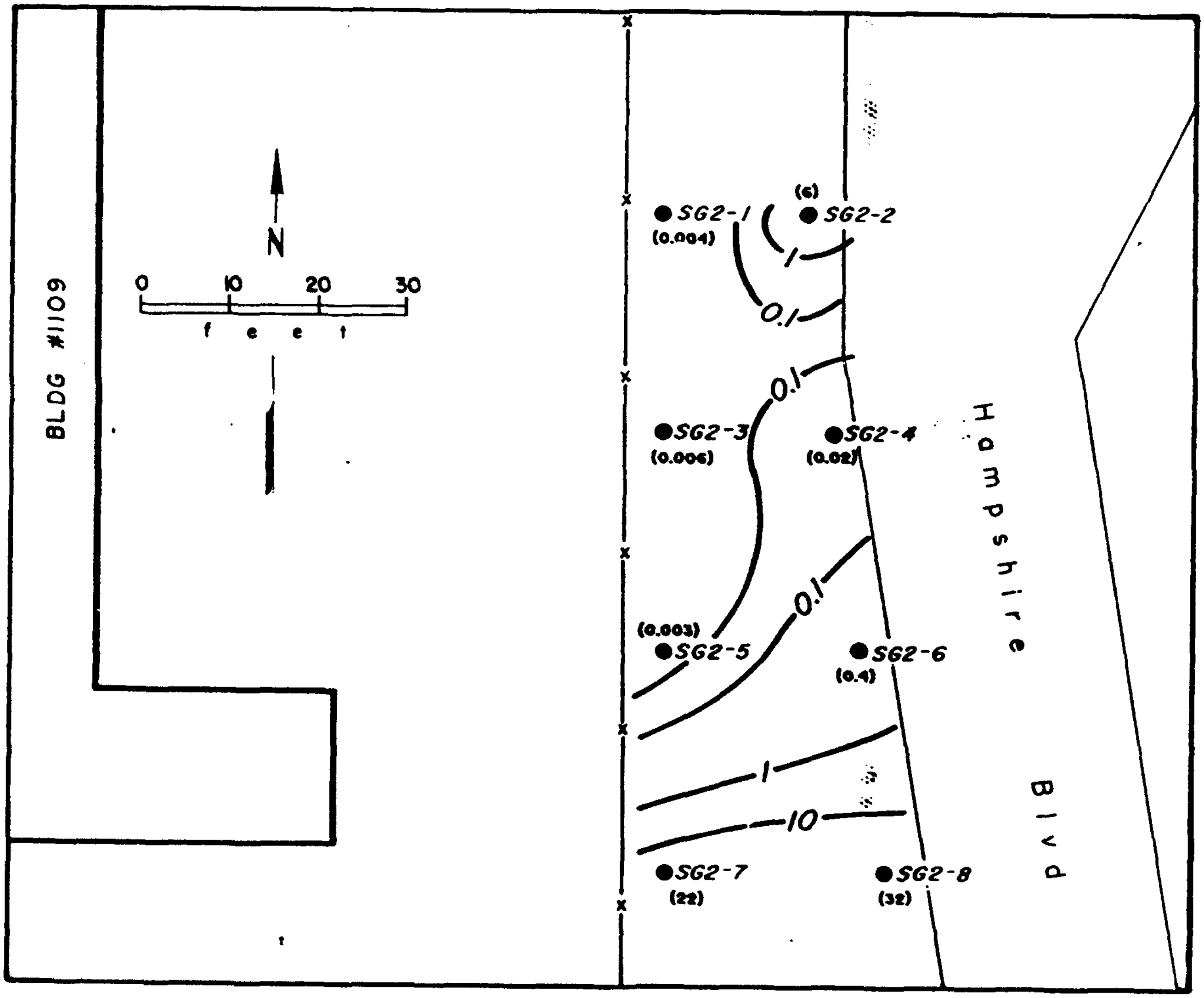


OREGON AIR NATIONAL GUARD
SITE No. 2 CIVIL ENGINEERING
HAZARDOUS MATERIALS AREA
PORTLAND, OREGON

TRICHLOROETHENE (TCE)

SEPTEMBER 1989

FIGURE 3



EXPLANATION

● SG2-1 SITE #2 SOIL GAS SAMPLING LOCATION

(0.004) SOIL GAS SAMPLE VALUE (µg/L)

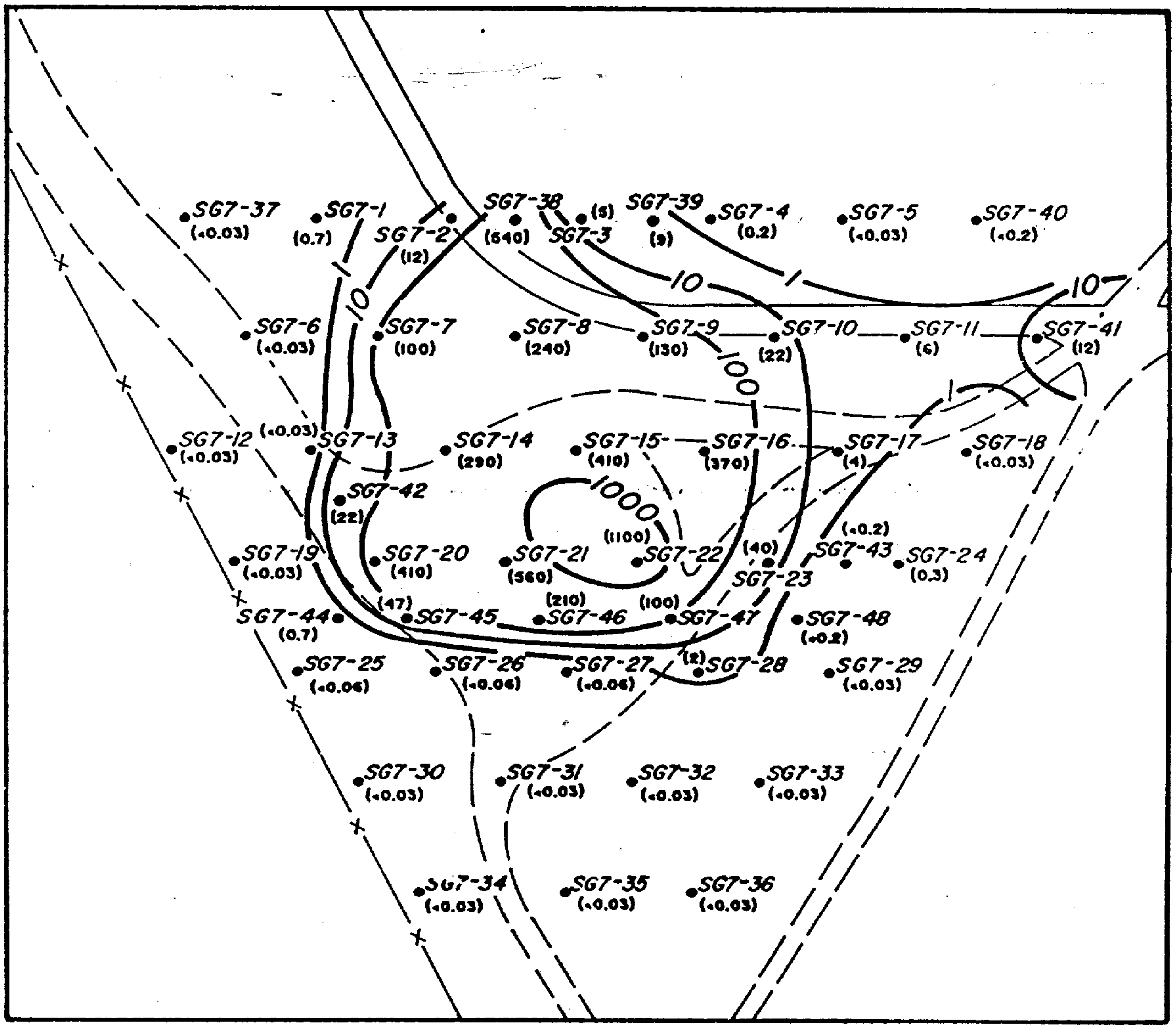
—0.1— ISOCONCENTRATION LINE (µg/L)

OREGON AIR NATIONAL GUARD
SITE No. 7 BURN PIT AREA
PORTLAND, OREGON

TOTAL HYDROCARBONS

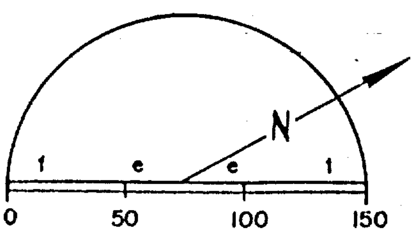
SEPTEMBER 1989

FIGURE 4



EXPLANATION

- ● SG7-1 — SITE #7 SOIL GAS SAMPLING LOCATION
- (0.7) — SOIL GAS SAMPLE VALUE (µg/L)
- —10— — ISOCONCENTRATION LINE (µg/L)



APPENDIX E

FIELD GC ANALYTICAL REPORT

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Andrew John Friedman
James E. Bruya, Ph.D.
(206) 285-8282

3008-B 16th Avenue West
Seattle, WA 98119
FAX: (206) 283-5044

March 27, 1989

RECEIVED
MAR 30 1989
SEATTLE

Daryl Jech, Project Leader
SAIC
13400-B Northup Way, Suite 38
Bellevue, WA 98005

Dear Mr. Jech:

Enclosed is the revised report of the analyses of samples submitted from January 24 to January 27, 1989 for on-site analyses for volatile compounds at the Portland, OR, Air National Guard Station.

I have reviewed the data that was generated at the site and subsequently compiled in our offices, compared them to the contract specifications, and determined that all of the analytical goals specified have been met, with the following exceptions:

1. Method 3810 specifies that the samples be heated to 90 degrees Centigrade before the headspace is withdrawn. It is our experience that this practice causes severe problems with analyte and water condensation resulting in highly irreproducible results. It is our practice to heat the samples only to 40 degrees Centigrade, which removes this problem.

2. No internal standards were used, and all calculations were done using external calibrations.

The data package itself meets all QA goals with the following exceptions:

1. The matrix spike results are outside of the desired range (+/- 30 %) in one of two samples on January 24th and January 25th and both samples on January 26th.

2. The result for trichloroethylene was outside of this range on January 27th in one of two matrix spike samples.

3. All analyte recoveries were outside of the desired range in one sample on January 26th. The data strongly suggest that this sample was spiked twice.

These results suggest that the data may slightly overestimate the concentrations of methylene chloride present in samples where it was reported. All such numbers have been so flagged in the data package.

All of the data was calculated by the chemist in the field and faxed daily to the Project Leader at Farr, Friedman & Bruya, Inc. for review. Once the project was finished, the Project Leader and the chemist went over all of the data to assure accuracy of the data generated. The final report was then reviewed by another chemist to determine that all of the data had been accurately transcribed to the final report. I have reviewed the final package and determined that all of the steps were completed. The data is ready for release.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Andrew John Friedman

Andrew John Friedman, Chemist

AJF

Enclosures

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 24, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE(1,2-DCE), BROMOCHLOROMETHANE(BrClMe), AND TRICHLOROETHYLENE(TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-5-1	<10	<10	<20	<10
SB1E-7-1	<10	<10	<20	<10
SB1E-7-2	<10	<10	<20	<10
SB1E-12-1	<10	<10	<20	<10
SB1E-12-2	<10	<10	<20	<10
SB1E-12-3	<10	<10	<20	<10
SB1E-17-1	<10	<10	<20	<10
SB1E-17-2	<10	<10	<20	<10
SB1E-17-3	<10	<10	<20	<10
SB1E-8-1	<10	<10	<20	<10
SB1E-8-2	<10	<10	<20	<10
Quality Assurance				
Method Blank	<10	<10	<20	<10
100ppb (Replicate)	99	88	70	81
SB1E-5-1 (Duplicate)	<10	<10	<20	<10
SB1E-5-1 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	120%	110%	86%	72%
SB1E-5-1 (Matrix Spike) (Replicate) Percent Recovery	150%	120%	96%	92%

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 25, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE (1,2-DCE), BROMOCHLOROMETHANE (BrClMe), AND TRICHLOROETHYLENE (TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-13-1	<10	<10	<20	<10
SB1E-13-2	<10	<10	<20	<10
SB1E-9-1	<10	<10	<20	<10
SB1E-9-2	<10	<10	<20	<10
SB1E-9-3	<10	<10	<20	<10
SB1E-14-1	<10	<10	<20	<10
SMW1E-2-1	<10	<10	<20	<10
SMW1E-2-2	<10	<10	<20	<10
SMW1E-2-3	<10	<10	<20	<10

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 25, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE(1,2-DCE), BROMOCHLOROMETHANE(BrClMe), AND TRICHLOROETHYLENE(TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SMW1E-2-4	<10	<10	<20	<10
SMW1E-2-5	<10	<10	<20	<10
SMW1E-2-6	<10	<10	<20	<10
Quality Assurance				
Method Blank	<10	<10	<20	<10
SB1E-13-1 (Replicate)	<10	<10	<20	<10
SB1E-14-1 (Replicate)	17[a]	<10	<20	<10
SB1E-13-1 (Duplicate)	<10	<10	<20	<10
SB1E-13-1 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	120%	130%	110%	110%
SB1E-14-1 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	150%	120%	130%	93%

a - Matrix spike recoveries were outside of the acceptable limits for this compound.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 26, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE (1,2-DCE), BROMOCHLOROMETHANE (BrClMe), AND TRICHLOROETHYLENE (TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-18-1	<10	<10	190	<10
SB1E-18-2	<10	<10	<20	<10
SB1E-18-3	<10	<10	<20	<10
SB1E-19-1	<10	<10	<20	<10
SB1E-19-2	<10	<10	<20	<10
SB1E-19-3	<10	<10	56	<10
SB1E-20-1	<10	<10	<20	<10
SB1E-20-2	<10	<10	<20	<10
SB1E-20-3	110[a]	<10	1,900	<10
SB1E-5-2	<10	<10	<20	<10
SB1E-6-1	<10	<10	<20	<10
SB1E-6-2	<10	<10	<20	<10
SB1E-10-1	<10	<10	<20	<10
SB1E-10-2	<10	<10	<20	<10
SB1E-16-1	<10	<10	<20	<10
SB1E-16-2	<10	<10	<20	<10

a - Matrix spike recoveries were outside of the acceptable limits for this compound.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 26, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE (1,2-DCE), BROMOCHLOROMETHANE (BrClMe), AND TRICHLOROETHYLENE (TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-16-3	<10	<10	<20	<10
SB1E-21-1	<10	<10	<20	<10
SB1E-21-2	<10	<10	<20	<10
Quality Assurance				
Method Blank	<10	<10	<20	<10
SB1E-18-1 (Replicate)	<10	<10	190	<10
SB1E-18-1 (Duplicate)	<10	<10	68	<10
SB1E-18-1 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	210%	100%	130%	62%
SB1E-18-3 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	300%	170%	180%	150%

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 27, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE (1,2-DCE), BROMOCHLOROMETHANE (BrClMe), AND TRICHLOROETHYLENE (TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-22-1	<10	<10	<20	<10
SB1E-22-2	<10	<10	<20	<10
SB1E-22-3	<10	<10	<20	<10
SB1E-14-2	99[a]	<10	12,000	<10
SB1E-15-1	<10	<10	340	<10
SB1E-15-2	<10	<10	380	<10
SB1E-11-1	<10	<10	250	<10
SB1E-11-2	<10	<10	200	<10

a - Matrix spike recoveries were outside of the acceptable limits for this compound.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Amended 3/27/89

Date of Report: January 31, 1989
Date Submitted: January 27, 1989
Project: Oregon Air National Guard (Portland)

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHYLENE CHLORIDE ($MeCl_2$), 1,2-DICHLOROETHYLENE(1,2-DCE), BROMOCHLOROMETHANE(BrClMe), AND TRICHLOROETHYLENE(TCE)

Sample #	$MeCl_2$ (ppb)	1,2-DCE (ppb)	BrClMe (ppb)	TCE (ppb)
SB1E-23-1	35[a]	<10	<20	<10
SB1E-23-2	<10	<10	<20	<10
SB1E-23-3	<10	<10	<20	<10
Quality Assurance				
Method Blank	<10	<10	<20	<10
SB1E-15-1 (Replicate)	<10	<10	410	<10
SB1E-22-1 (Replicate)	<10	<10	<20	<10
SB1E-22-1 (Duplicate)	<10	<10	<20	<10
SB1E-23-1 (Duplicate)	38[a]	<10	<20	<10
SB1E-22-1 (Matrix Spike) Spiked @ 100 ppb Percent Recovery	130%	110%	100%	84%
SB1E-23-1 (Matrix Spike) Spiked @ 50 ppb Percent Recovery	100%	83%	110%	62%

a - Matrix spike recoveries were outside of the acceptable limits for this compound.

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D.
Andrew John Friedman
James E. Bruya, Ph.D.

3008 B - 16th West
Seattle, WA 98119
(206) 285-8282

February 24, 1989

RECEIVED

MAR 3 0 1989

SEATTLE

Gentlemen:

The following is a brief description of the on-site analysis method used for the Oregon Air National Guard project which began on January 23, 1989 and terminated on January 27, 1989

A Varian Aerograph, Series 1200 gas chromatograph equipped with a flame ionization detector was used. The column used was 10' X 1/8" stainless steel, with 4% carbowax 20-M plus 0.8% KOH in carbopak B, 60/80 mesh packing material. The carrier gas flow was pre-pure grade Nitrogen at 30 ml/min measured at the column out flow. The injector temperature was held at 200 ^{o}C, detector temperature held at 270 ^{o}C, and column temperature at 150 ^{o}C. The signal was recorded using an H.P. 3393A computer/integrator.

Standard mixtures were prepared from pure compounds at initial concentrations of 1,000 ppm, in methanol and sealed in 1 ml vials. These vials were stored in refrigerated conditions for the duration of the project and used at the frequency of one vial per calibration (approx 1 per day). Bromochloromethane bottled separately, was added as necessary to serial dilutions of all the compounds.

The headspace method of analysis entailed the use of 15 grams of sampled material transferred to 20 ml vials, using a stainless steel spatula. The vials were filled to a 5 ml headspace mark with distilled H_20 and sealed with a crimpcap and teflon-lined septa. The homogeneous soil water mixture was heated to a temperature of 40 ^{o}C in a constant temperature bath. An aliquot of 500 µl of the headspace was measured for G.C. injection using a 1,000 µl Hamilton gas-tight syringe.

Quality assurance and quality control were followed as per the contract specifications. Blanks and matrix spikes were run daily, as were duplicates and replicates at a frequency of 10% of each day's sample load. These conditions were met or exceeded for the project duration. Some variability was noted for recoveries of matrix spikes and some continuing calibration runs. It was the chemists prerogative to determine if this was due to the instrument inconsistencies, matrix effects, or human error. Generally the variability was held to +- 30% of expected results. If this range was exceeded, the analysis was repeated until at least one set of satisfactory results were obtained. January 26 sample SB1E-18-1 showed results outside the range, for the duplicate analysis of bromochloromethane, as well as recoveries for dichloromethane and trichloroethylene in the matrix spike. Sample variability due to non-homogeneity is attributable to the former analysis. In the latter analysis it is apparent matrix effects may be involved.

Sincerely,

James K. Farr

James K. Farr

JKF/ddh

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Andrew John Friedman
James E. Bruya, Ph.D.
(206) 285-8282

3008-B 16th Avenue West
Seattle, WA 98119
FAX: (206) 283-5044

RECEIVED
MAR 30 1989
SEATTLE

March 28, 1989

Daryl Jech, Project Manager
SAIC
13400-B Northup Way, Suite 38
Bellevue, WA 98005

Dear Daryl:

This is in follow-up to your request for additional information regarding the possible identities of the extra peaks found during the analyses on soil samples between January 24 and 27, 1989, at the Oregon Air National Guard facility.

We have reviewed the chromatograms and have prepared a graphic representation of the peaks that were seen but not reported in the original data set. Where a tentative identification was made, I have labelled the column accordingly. The analytes researched after the project included benzene, toluene, ethylbenzene, xylenes, and hexane. Hexane, benzene, and toluene were eluted within the analysis used on-site. However, the larger hydrocarbons, including ethylbenzene and the xylenes were not analyzed. A significant amount of late eluting material was evident in three samples: SB1E-14-1, SB1E-14-2, and SB1E-18-1.

The small x's indicate where significant peaks were found in the GC/FID chromatograms. "Significant" means any peaks exceeding the response of a 10 ppb standard of dichloromethane. The numbers underneath the "x" represent the estimated amount of contamination present, again based on a dichloromethane response.

Almost all samples gave peaks that eluted in the 1.0 to 1.3 minute range. This was probably a consequence of a leaking propane tank in the mobile lab. This was discovered and corrected late in the project and did not interfere with the analytes of interest.

If I can be of further assistance or can clarify any of the information enclosed, please feel free to contact me.

Sincerely,

Thomas M. Stapp

Thomas M. Stapp, Chemist

TMS/ddh

Enclosures

Sample Number	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4
Time (min.)			a	b	c	d		e		f						g						
SBIE-05-1		X						X 10														
SBIE-07-2		X																				
SBIE-07-1		X 90						X 20														
SBIE-12-1		X 75						X 10														
SBIE-12-2		X						X 10														
SBIE-12-3		X				X <10		X 10														
Method Blank		X				X 10		X 15														
SBIE-17-1		X						X 20														
SBIE-17-2		X						X 10														
SBIE-17-3		X																				
Benzene @ 100 ppb		X						X 100														
SBIE-08-1		X					X 10															
SBIE-08-2		X																				

(All unmarked above under 1.4 min are approx. 100 ppb)

January 24, 1989 Analysis

a - Dichloromethane
b - 1,2 t-DCE
c - BrCl methane
d - Hexane
e - Benzene
f - TCE
g - Toluene

Sample Number	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4
Time (min.)			a	b	c	d		e		f						g						
SBIE-13-1	X																					
SBIE-13-2		X																				
SBIE-09-1	X																					
SBIE-09-2		X																				
SBIE-09-3	X																					
SBIE-14-1		X					XX 20 20	X 20	X 20			X 10		X 20								X 40
SMWIE-02-1	X																					
Method Blank	X						X 5	X 5														
SMWIE-02-2	X																					
SMWIE-02-3	X																					
SMWIE-02-4	X																					
SMWIE-02-5	X					X 30		X 100														
SMWIE-02-6	X																					

(All above under 1.3 min are approx. 100 ppb)

January 25, 1989 Analysis

a - Dichloromethane
b - 1,2 t-DCE
c - BrCl methane
d - Hexane
e - Benzene
f - TCE
g - Toluene

Sample Number	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4
			a	b	c	d		e		f						g						
Method Blank	XX						X <10															
SBIE-18-1	XX																					
SBIE-18-2	XX																					
SBIE-18-3	X																					
SBIE-19-1	XX																					
SBIE-19-2	XX																					
SBIE-19-3	X																					
SBIE-20-1	XX																					
SBIE-20-2	XX																					
SBIE-20-3	XX		X 50																			
SBIE-05-2	XX																					
SBIE-06-1	XX												X 75									
SBIE-06-2	XX																					
SBIE-10-1	XX																					
SBIE-10-2	XX																					
SBIE-16-1	XX																					
SBIE-16-2	X																					
SBIE-16-3	XX																					
SBIE-21-1	XX																					
SBIE-21-2	X																					

Time (min.)

After 9 min. Multiple Peaks >50 ppb

(All above under 1.3 min are approx. 100 ppb)

January 26, 1989 Analysis

a - Dichloromethane
b - 1,2 t-DCE
c - BrCl methane
d - Hexane
e - Benzene
f - TCE
g - Toluene

Sample Number	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4
			a	b	c	d		e		f						g						
SBIE-22-1	X	X																				
SBIE-22-2	X	X																				
SBIE-22-3	X	X																				
SBIE-14-2	X	X																			X 10	
SBIE-15-1		X																				
Method Blank		X																				
SBIE-15-2		X																				
SBIE-11-1		X																				
SBIE-11-2		X																				
SBIE-23-1	X	X																				
SBIE-23-2		X																				
SBIE-23-3		X																				

Time (min.)

(All above under 1.4 min are approx. 100 ppb)

January 27, 1989 Analysis

a - Dichloromethane
b - 1,2 t-DCE
c - BrCl methane
d - Hexane
e - Benzene
f - TCE
g - Toluene

APPENDIX F

GEOPHYSICAL SURVEY REPORT

water content and dissolved salts or ions. Accordingly, dry sands and gravels, and massive rock formations have low conductivity, while saturated sands and gravels, most clays, and other materials with high ion content have high conductivity. Landfill areas and buried metal objects often have different conductivity than surrounding terrain, and therefore produce anomalies.

1.2 INSTRUMENTATION

The surface EM conductivity survey was conducted at Site 8 using a Geonics Limited EM31-DL surface conductivity meter which measures both quadrature-phase and in-phase components. The quadrature-phase component gives the apparent conductivity measurement (McNeill, 1984). The instrument is sensitive to conductive surface materials (e.g., fences, tanks; McNeill, 1980), so transect lines need to be oriented, if possible, to avoid such interference. If it is not possible to avoid surface conductive materials, interpretation of data must take these features into account. The instrument provided good quality data for the apparent conductivity ranges at ANG Portland (-40 to 150 mS/m). The data were recorded using an Omni DL-55 Polycorder Digital Data Recorder which continuously collected and stored apparent conductivity and in-phase data at user-defined intervals (1 second or every 3 feet).

1.3 SURVEY PROCEDURE

Prior to any measurements, instrument nulling was calibrated and checked to ensure a set zero, and the instrument phase was adjusted to ensure data readings were maximized. The instrument compensation was also checked to ensure that instrument sensitivity was correct. These parameters were recorded in the field notebook and checked periodically to assure that instrument drift was negligible during the survey.

The data recorder was set so that an initial station number (distance along each transect), transect direction, and station increment (3 ft) were stored internally. The initial station was set at either zero or the farthest station distance depending on which end of a transect the operator started. The data recorder automatically read apparent conductivity at each station as

the operator walked along the transect, timing his pace at approximately 3 ft/sec (the data recorder automatically increments the station by ±3 as set previously at the start of the transect). Marking stakes were placed at 50 ft along each transect to ensure correlation between the instrument increment reading and true distance. At the end of each transect the operator moved to the next transect and reset the initial station, direction, and station increment. Any observations such as possible surface conductors, standing water or creeks, earth subsidence, and visual landfill were recorded.

When the survey was completed, the data were downloaded into a field computer, and visually inspected to ensure data quality were adequate. The data were profiled using a software package provided by Geonics Limited (DAT31Q, 1989). No curve smoothing on profiles was necessary due to the near continuous nature of the data. Data were processed further by contouring using a commercial software package (Golden Software, Inc.). For final figures, the contoured data were gridded using a Kriging algorithm and smoothed using a cubic spline routine to provide clearer contour maps. The maps were examined closely to ensure no fictitious contours were generated during data reduction. All resulting profiles and contour maps are included in Attachment A.

2.0 MAGNETIC SURVEY PROCEDURES

2.1 THEORY

The proton precession magnetometer is an instrument which measures the total magnetic field of the earth. The instrument operates by using a sensing device filled with a proton-source fluid (decane in this case). The sensing device contains a coil which induces a polarizing field approximately normal to the terrestrial field. When the polarizing field is suddenly removed (i.e., the current is stopped in the coil), the protons align with the terrestrial field and precess at an angular velocity known as the Larmor precession frequency. This frequency is proportional to the terrestrial field intensity. Because the proton is a moving charge, it induces a voltage in a pickup coil (located in the sensor) which varies at the precession frequency. The signal from the pickup coil is sent to the instrument where it is amplified, and linearly related to the terrestrial field.

Landfills (which often contain high amounts of reinforced concrete and other metal objects) generally have higher magnetic susceptibilities than the surrounding soils and bedrock, therefore causing local anomalies with respect to the natural field. The advantages of the proton precession magnetometer are the speed at which surveys can be conducted, and the ease of operating the instrument. The magnetometer cannot be reliably operated in areas that are known sources of radio frequency energy, where transformers are present, in buildings, or near highly magnetic objects. Instrument resolution is reduced in areas of high gradient, rapid diurnal changes, and in the presence of magnetic dust. Survey grids were located to best avoid areas causing unreliabilities, and great care was taken to assure the sensor was free of dust. However, measurements are often collected near strongly magnetized surficial objects, and the resulting anomalies need to be taken into account during interpretation. Diurnal variations in the earth's total magnetic field were monitored closely by repeated readings at a base station as discussed below.

2.2 INSTRUMENTATION

The magnetic survey at ANG Portland was conducted using an EG&G Geometrics G-856AX portable proton precession magnetometer. The instrument consists of a sensor mounted on an 8-foot pole and an instrument which reads and stores the acquired data. The magnetometer sensor is mounted on the pole to avoid small surficial magnetic effects. The G-856 magnetometer displays and records total magnetic field data with a resolution of 0.1 nT (the SI unit for magnetic induction field). Magnetic readings were taken at EM conductivity survey grid stations to provide continuity between data sets.

2.3 SURVEY PROCEDURE

Prior to initiating the survey, the operator removed magnetizable objects from his person, including knives, steel-toed boots, compasses, and other metal objects, and checked the sensor to ensure that no dirt particles adhered to its surface. The instrument voltage was then checked to ensure it was greater than 7.5 volts, and the internal clock of the instrument was checked and adjusted to local time if necessary. The instrument was then tuned to the local magnetic field ensuring the strongest possible signal strength.

Upon completion of these initial calibrations, the "heading effect" was checked. This variation is caused by the effect of sensor orientation on the measured total field intensity. This parameter is determined by taking readings in four positions (north, south, east, west) while pivoting the instrument around the same grid position. For a survey accuracy of 1 nT, heading error should be 2 nT or less (Breiner, 1973). All the above data and parameters were recorded in the field notebook. Three successive readings were collected at each station to ensure that data were not varying above the required survey accuracy (±1 nT). A base station was occupied at the start of the survey, reoccupied after every two transects, and at the end of the survey to monitor diurnal changes closely. Readings were then measured at designated grid stations as follows. The arrow on top of the sensor was oriented north, and then three successive readings were collected at each grid station, storing the first reading internally in the magnetometer, and recording all three in the field notebook along with station identification, time, date, site, transect, spacing, and any observations. Transect number, grid spacing, and site number were stored in the magnetometer to correspond with each reading.

Upon completion of the survey the data was automatically transferred from the magnetometer to a computer file where it was quantitatively processed using EG&G Geometrics MAGPAC software, which allows the user to remove diurnal variations, plot profiles, and plot variable density contour plots in the field. The field data file was then further processed where the data were gridded using a Kriging algorithm and smoothed using a cubic spline method to provide a contour map. Resultant profiles and contour maps are located in Attachment A.

3.0 GEOPHYSICAL RESULTS

The purpose of these surveys was to locate a landfill area described as 3 to 6 trenches arrayed in random orientation in the center of Site 8 as shown by the shaded area in Figure F-1. The survey grid was oriented north-south and east-west. The grid extended 250 ft north of the east-west fence along the perimeter road and 500 ft east of the fence surrounding Building 160. The grid was shorter in the north-south direction than originally planned because

of new construction which prevented the collection of data towards the north. The following subsections discuss the results of the geophysical surveys in detail.

3.1 SURFACE EM CONDUCTIVITY RESULTS

The EM conductivity survey data were collected in two directions: along the east-west direction with transect number increasing towards the north, and along the north-south direction with transect number increasing towards the east. The survey was conducted in two directions because of the strong affect instrument orientation can have on results and interpretation. Figure F-1 shows the orientation of the survey grid with designated station number or transect numbers (i.e., the two numbers interchanged depending on the orientation of the survey grid; e.g., while the survey was conducted along the east west profiles, the station number increased to the east from 0 to 500 and the transect number increased to the north from 0 to 250. The station number and transect number were assigned opposite roles when the survey was conducted in the other orientation). Profiles and contour maps from each orientation can be found in Attachment A, and the raw field data are available from SAIC.

The profile data show the two parameters that were collected: quadrature-phase (or apparent conductivity) and in-phase data. The apparent conductivity data are represented by the solid-line curve on each profile, and units (mS/m) are read from the left of the graph. Conversely, the in-phase data are represented by the broken-line curve and the units (parts per thousand, ppt) are read from the right side of the graph. In-phase data may be extremely sensitive to buried or surficial metal objects (McNeill, 1984), which makes both of these parameters important for delineating subsurface conductivity changes.

An area assumed to represent the natural soil conditions was used to collect a background profile. This profile is located in Attachment A. The data show very little fluctuation, and the apparent conductivity was measured between 20 and 25 mS/m.

The east-west transect data show several anomalies. Along profile 000(V) [the (V) designates that the data were collected in the vertical dipole mode] apparent conductivity and in-phase data increase is at about 150 ft along the profile, and this increase extends the rest of the profile length. It has been concluded that this anomaly is caused by the fence that parallels the perimeter road. On all other east-west transect profiles an anomaly is observed in which a slight increase in apparent conductivity (and in-phase data) is observed subsequently followed by a sharp drop and rise and then a levelling of the data to background conductivity within a short distance. These are characteristic of anomalies caused by orthogonally crossing utilities or buried pipes (McNeill, 1984). One anomaly as described above is located at approximately 150 to 160 ft along each data profile. This anomaly is caused by a buried 1200 volt northwest-southeast power line which crosses the site from the corner of the base property fence near the golf course and supplies power to Building 250. A second anomaly is observed on transect data profiles 150(V) through 250(V) between 370 and 450 ft. This anomaly is caused by a second power line and a communications line. The change in the anomaly location along subsequent transect profiles is because the lines are set at an angle to the grid orientation.

One further anomaly is observed on the east-west transect data profiles. At the west end of profile 150(V) a rise in conductivity and in-phase data is observed. The only known underground utilities in this area are set east-west, parallel to transect 150(V). If the increase were caused by these utilities, the anomaly pattern would be observed along the entire length of the profile. However, since the increase in data is not observed elsewhere along the transect, the anomaly must be caused by some other source: possibly buried construction materials or demolition rubble, unknown utilities, or possibly a landfill trench. Some metallic objects (rusted steel bands) were noted on the surface in this area at the start of the survey, but were removed before commencement of the field survey. Also it is possible that a utility which was not noted on base maps exists in this area. An old storm drain system was noted while conducting the survey, and it is unknown which direction this storm drain system turns, if any. Further, the addition of another utility in an area already high in utilities would cause a larger anomaly. The anomaly was not detected on transect profiles from either side,

which suggests that the source of the anomaly is relatively thin. However, the extent of this anomaly does not correspond with the described site characteristics of 3 to 6 trenches located toward the center of the gridded area as indicated previously in the IRP Phase I Report.

The north-south transect data profiles show two distinct anomalies which correspond with the utilities which parallel O'Conner Way, and are buried directly to the north and south of this pre-existing road. These anomalies are observed on all north-south transect profiles. Transect profiles 000(V) and 050(V) show distorted anomalies over these utilities which may be caused by superposition of response from other sources. Examples of other sources are discussed in the preceding paragraph. Transect profile 400(V) shows some variation (180 to 230 ft) to the north. These anomalies are caused by the power line which splits from the main east-west electric line and bisects transect profile 400(V).

The contour map of east-west conductivity and in-phase data shows a strong east-west linear trend through the center of the site. This trend is caused by the east-west utility lines which parallel O'Conner Way. A strong linear trend is also observed towards the south of the site. This linear trend is caused by the base boundary fence near the golf course. A strong anomaly is also observed at the west end of the site between 0 and 150 ft along transect 150(V) where the data readings increase considerably compared to the linear anomalies caused by the utilities throughout the center of the site. The cause of this anomaly is unknown, but could be due to buried construction debris, unknown utilities, or a buried landfill trench.

The north-south apparent conductivity and in-phase data contour plot shows several anomalous trends. One linear anomalous trend is observed in the southern portion of the site. This anomaly is caused by the base boundary fence that parallels the perimeter road. Another linear anomalous trend is a seen south-to-north between approximately 125 and 175 feet west to east. This trend is not obvious on the in-phase contour plot, but is very strong on the apparent conductivity plot. This anomalous trend is caused by the buried high power line which crosses the site in this area. A east-to-west linear trend is also observed on these north-south transect contour plots, but is not

as pronounced as in the east-west transect contour plots because the instrument orientation causes different features to be emphasized. Such emphasis shows clearly in contour plots (i.e., the north-south transect data emphasizes subsurface features which trend north to south while the opposite is true for the east-west transects). However, this trend is caused by the utilities parallel to O'Conner Way. Finally, a strong increase in conductivity and in-phase data is noted at the west end of the plot between 150 to 200 feet north. The cause of this anomaly is unknown, but, as discussed with the east-west transect data, it could be caused by several different things such as buried construction debris, unknown utilities, or a buried landfill trench.

3.2 MAGNETIC SURVEY RESULTS

The magnetic data were collected at 50-foot spacings at each point within the gridded area as shown in Figure F-1. The data were collected moving west to east along transect profiles. Transect profile number increased from south-to-north. Because the magnetic reading is a point-source measurement, orientation of the instrument with respect to the grid does not affect results or interpretation.

Readings were initially collected at the base station to give an idea of field strength at the site. Using these results, the instrument was then tuned to 54.3K nT. The "heading effect" was then measured and gave a mean of 54356.6 nT a standard deviation of 0.2 nT, and a coefficient of variation of 0.0003%.

The magnetic data can be highly variable due to structures which may exhibit high induced magnetization (buildings, fences, etc.). The transect profile data and the contour plot show some anomalies due to man-made features at the site. As seen on the transect profiles (located in Attachment A) the data show several steep anomaly changes. When looking at the magnetic profile data, the line number corresponds with transect number as used in this discussion. Transect profile 0 shows a high amount of variation caused by the base boundary fence which parallels the perimeter road. Likewise, transect profiles 50 and 100 show a steep decrease on the west side caused by the fence surrounding the motor pool yard (Building 165). This fence bends west after transect 100, and therefore does not cause anomalies on subsequent transect

data profiles. The transect data profiles show some small variations, but these localized changes are most likely caused by remnant magnetism in the basaltic bedrock. Two other strong anomalies can be noted on the magnetic transect profiles. The first strong anomaly is noted on transect profile 150 approximately 100 feet from the west side of the site. The cause of this anomaly is unknown, but it's location at the site is approximately the same as observed in the EM data and it may be caused by the same source(s) as described in Section 2.1. The second strong anomaly is noted on transect data profile 250 at approximately 350 to 400 feet from the west end of the grid. This anomaly is caused by a large steel-reinforced concrete structure close to the transect line.

The magnetic data contour plot shows a general decrease of total magnetic field to the north of the gridded area. This trend is most likely due to some large scale trend in the basement rock. The anomalies noted in the northeast corner of the site are caused by a steel reinforced concrete structure. The anomalies observed in the southwest corner and the south part of the gridded area are caused by fences. The cause for the "bulls-eye" anomaly towards the west side of the site is unknown, but may be caused by buried metal objects in this area. The size of this anomaly appears large in the contour plot, but this size may be a function of contouring because the data are not anomalous in this area on transects 100 or 200 (directly to the south and north respectively).

4.0 SUMMARY OF GEOPHYSICAL SURVEY FINDINGS AND CONCLUSIONS

Electromagnetic (EM) and total field magnetic surveys were conducted over a 250-by-500-foot gridded area at Site 8 for the ANG Portland SI. The purpose of this survey was to locate a landfill area reported to include 3 to 6 trenches constructed in random orientation in the center of Site 8. A summary of the findings follows:

- The EM survey revealed linear anomaly patterns in the north-south and east-west directions which corresponded with marked utility lines. However, one small area was detected to the west side of the site which exhibited higher conductivities than surrounding areas. The source for this anomaly is unknown.

- The magnetic survey showed anomalies caused by man-made features. However, these anomalies did not affect interpretation because of their location with respect to other anomalies. The survey shows one anomalous area toward the west end of the site which may be caused by buried metallic material.

Both the EM and magnetic surveys indicated an anomalous area towards the west side of the site (refer to Figure F-2). The anomaly appears to trend further west, but predictions of how far west it may extend cannot be made. This anomalous area may be caused by several things including: buried construction debris, unknown utilities, or possibly a buried landfill trench. Construction debris was noted and removed from the surface of this area before the survey commenced. Also, it is possible that a utility which was not noted on base maps exists in this area. An old storm drain system was noted while conducting the survey, and it is unknown if or in which direction this storm drain system leaves the site. Furthermore, the addition of another utility in an area already dense with utilities would cause a larger anomaly.

In summary, the EM and magnetic surveys revealed several anomaly patterns, all but one of which corresponded with obvious structures, marked utility lines or fences. This "unexplained" anomaly was detected on the western portion of the site and exhibited higher conductivities than surrounding areas. The source for this anomaly was not apparent. However, its shape did not match the pattern expected for the suspected landfill trenches (i.e., several trenches of random orientation relatively close to each other). In addition, the anomaly could have been caused by other phenomena, such as unmarked utilities or complex electromagnetic interactions between two underground power lines which cross each other near the anomaly. Hence it is concluded that there is insufficient evidence from the geophysical survey to indicate the presence of the described landfill trenches within the surveyed area, and that none of the anomalies observed in the geophysical data were likely attributable to the suspected landfill trenches as described by the former Base Deputy Civil Engineer. It is possible that whatever trenches he recollects might have existed outside of the the surveyed zone.

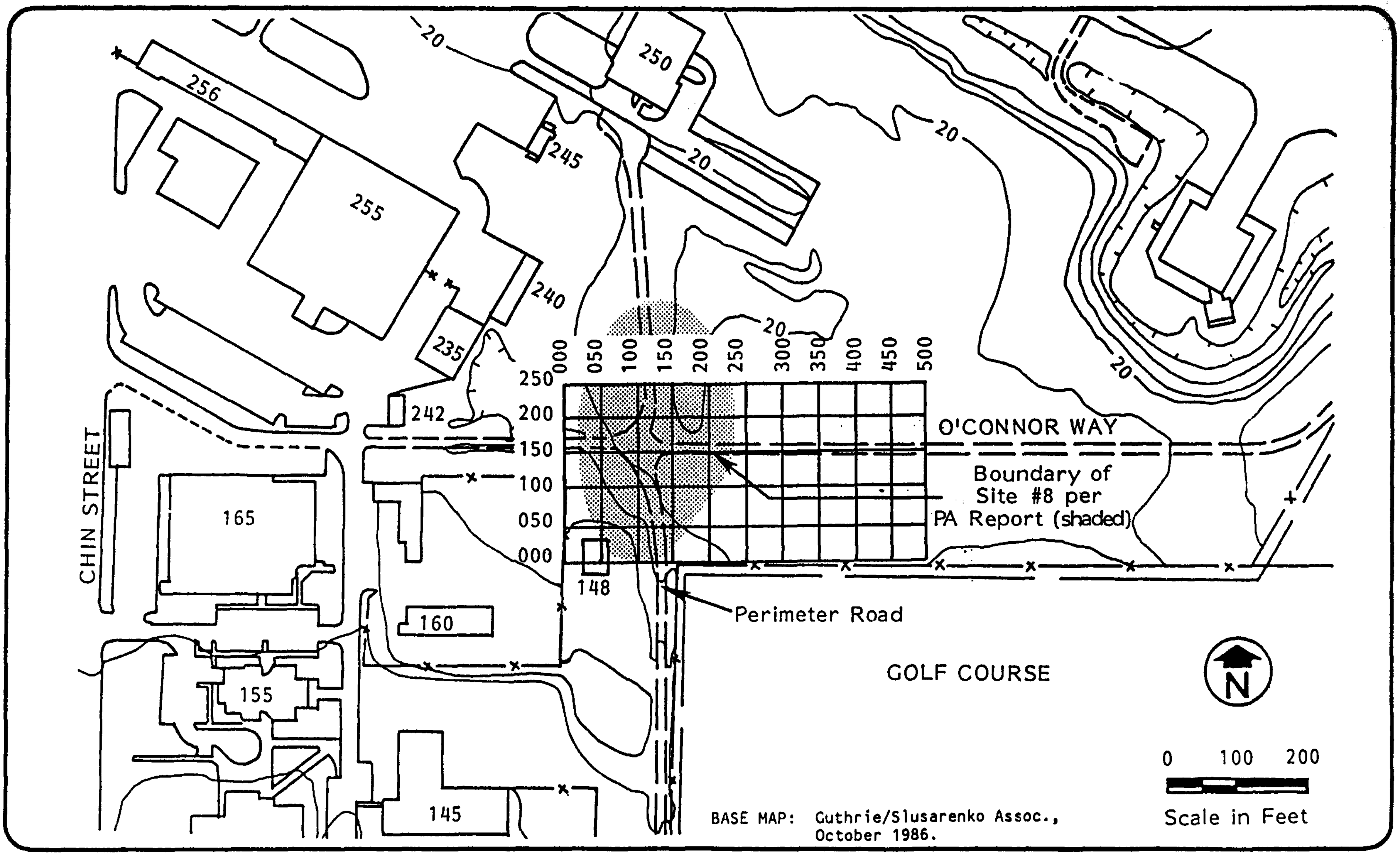


Figure F-1

LOCATION OF GEOPHYSICAL SURVEY GRID
SITE 8 – ANG PORTLAND, OREGON

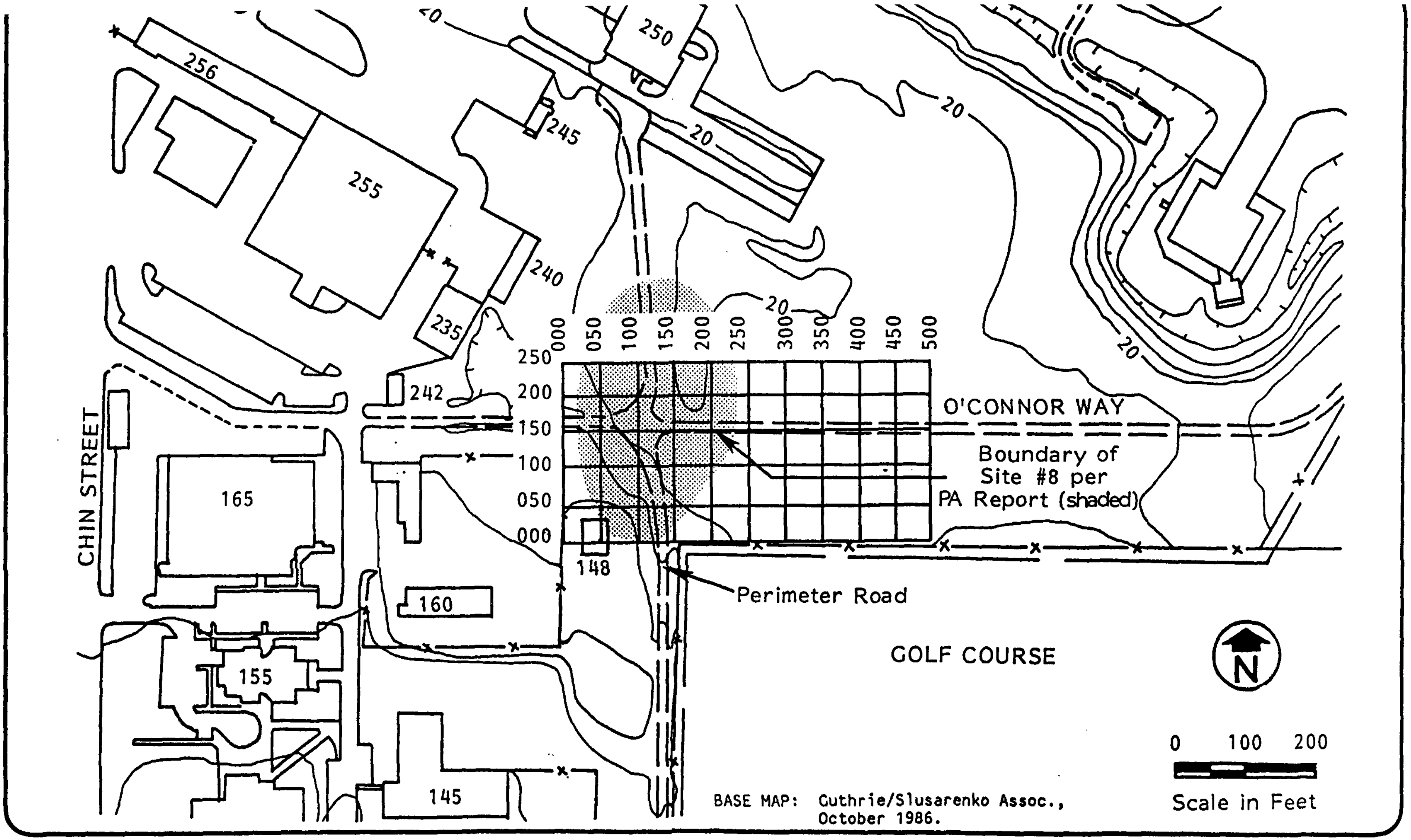


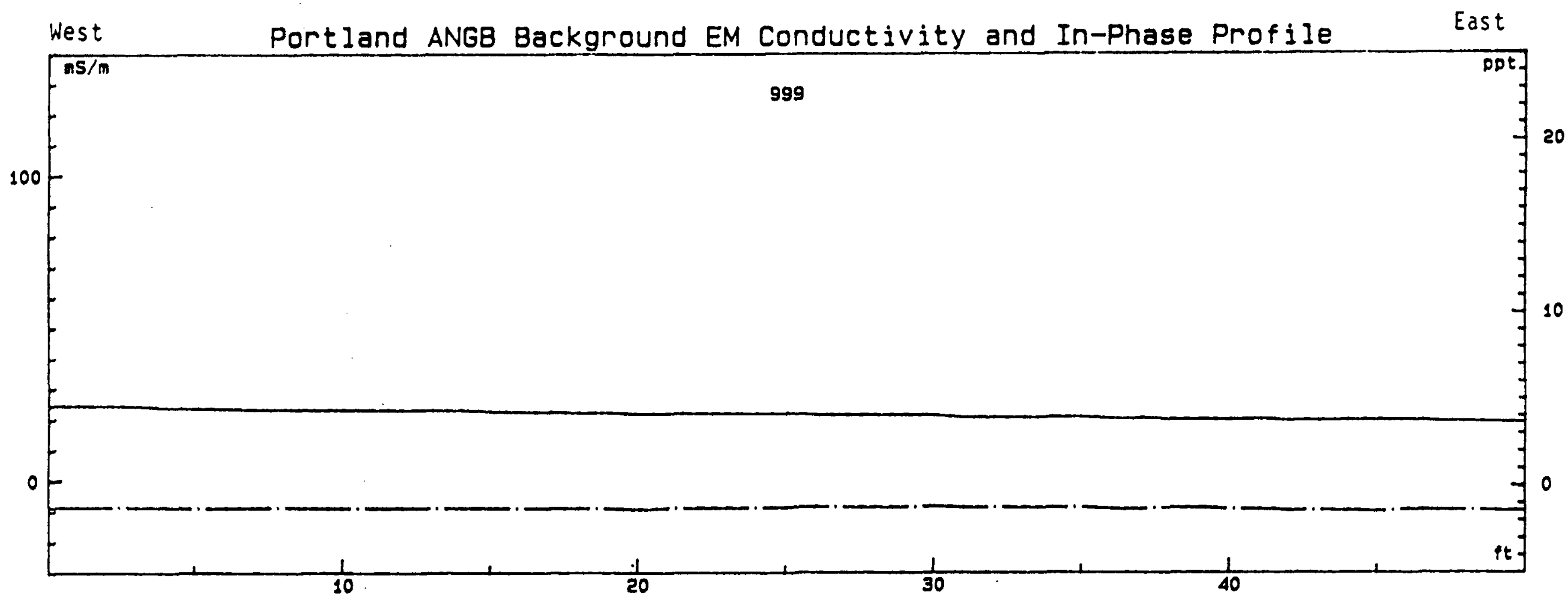
Figure F-2

LOCATION OF UNEXPLAINED ANOMALOUS REGION
SITE 8 – ANG PORTLAND, OREGON

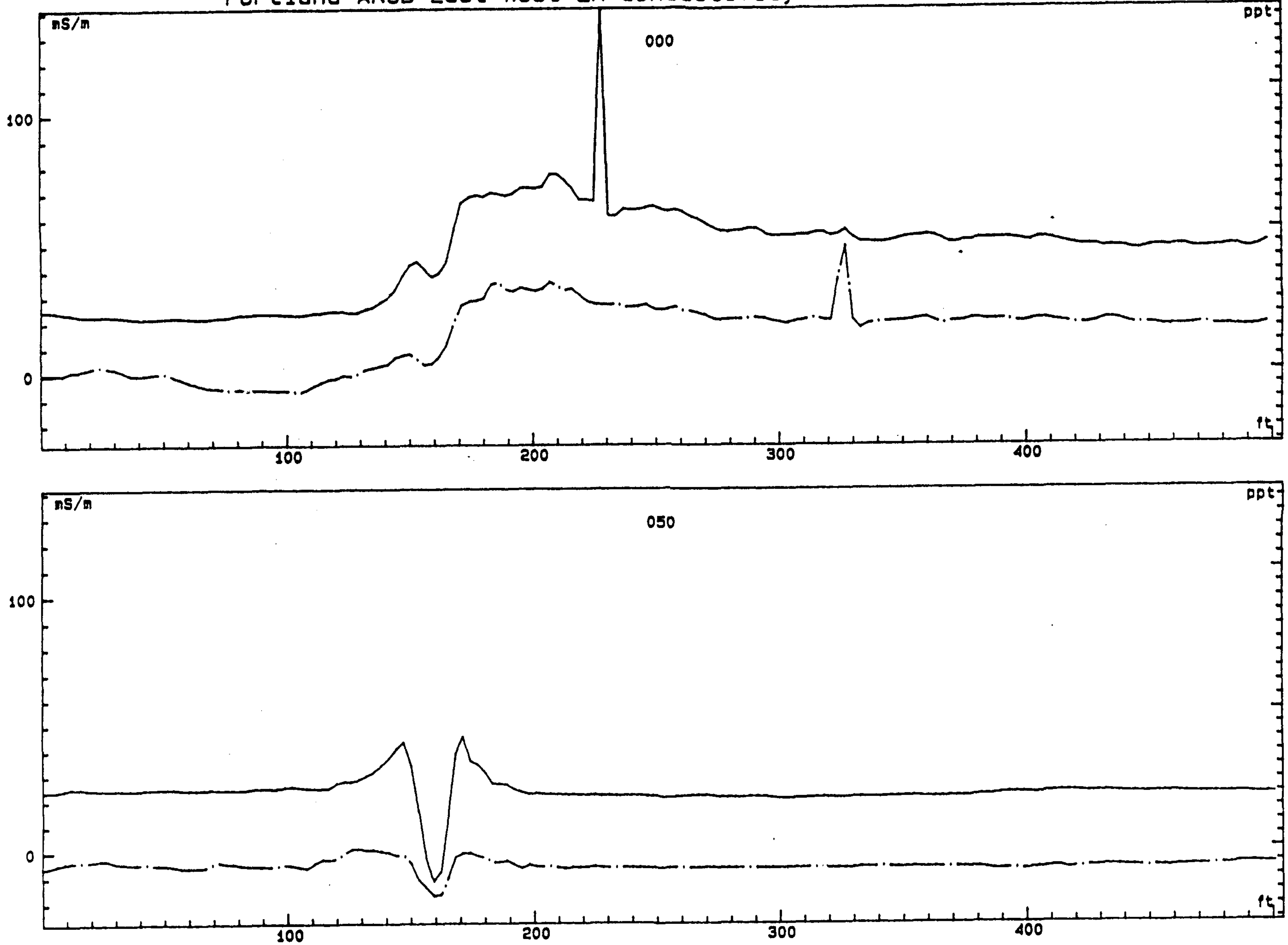
ATTACHMENT A

PROFILE AND CONTOUR PLOTS

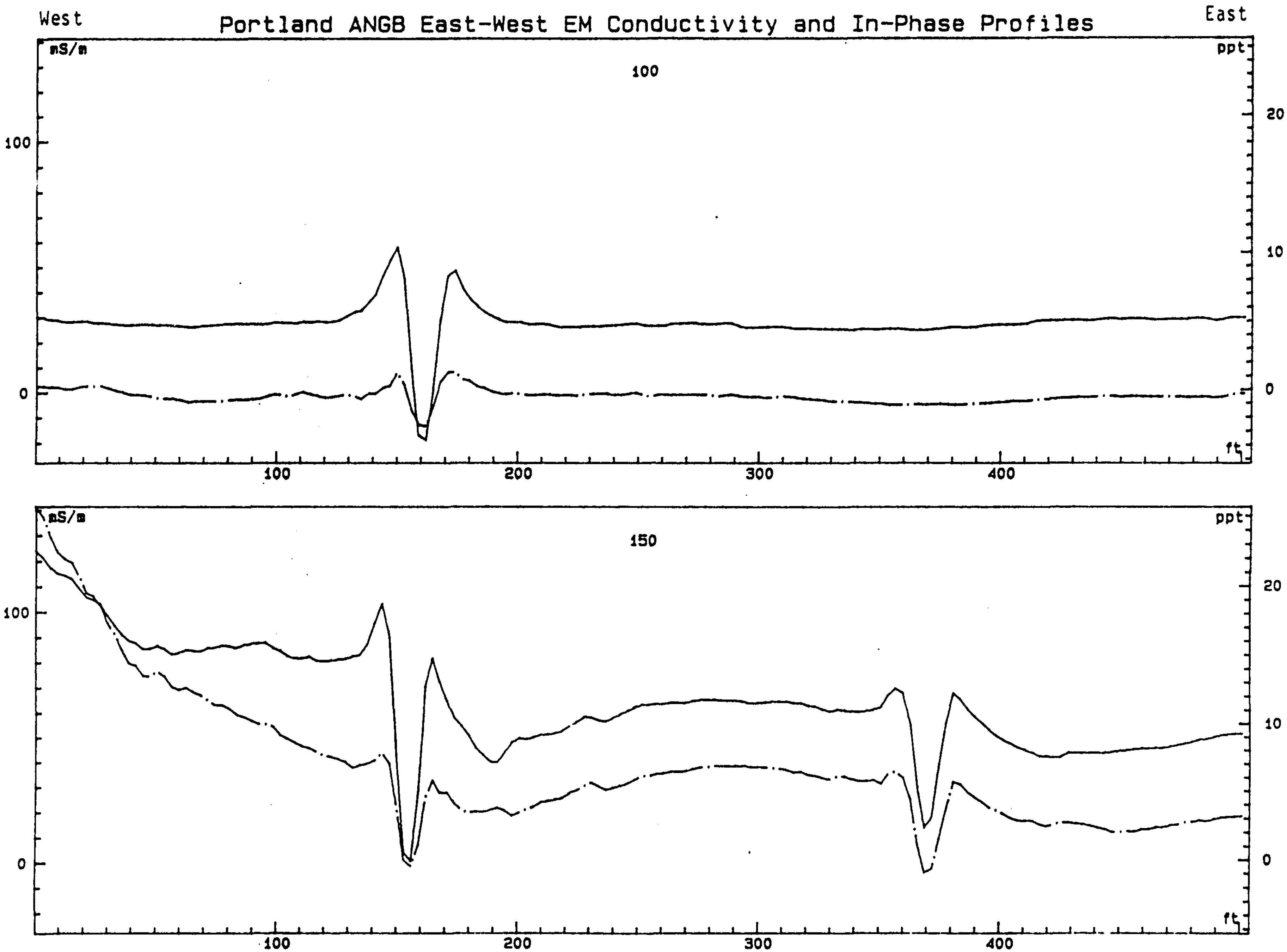
Portland ANGB Background EM Conductivity and In-Phase Profile



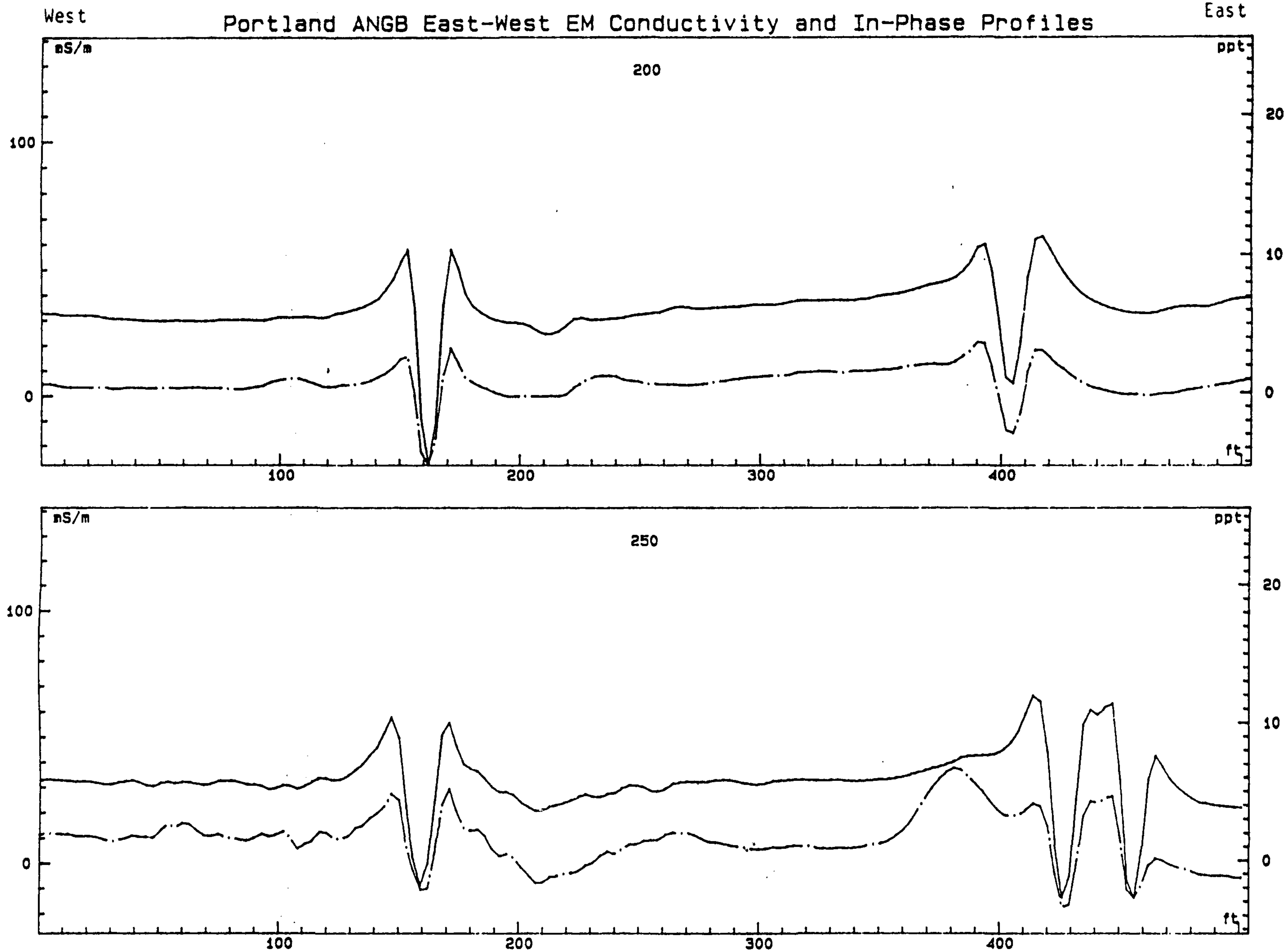
West Portland ANGB East-West EM Conductivity and In-Phase Profiles East



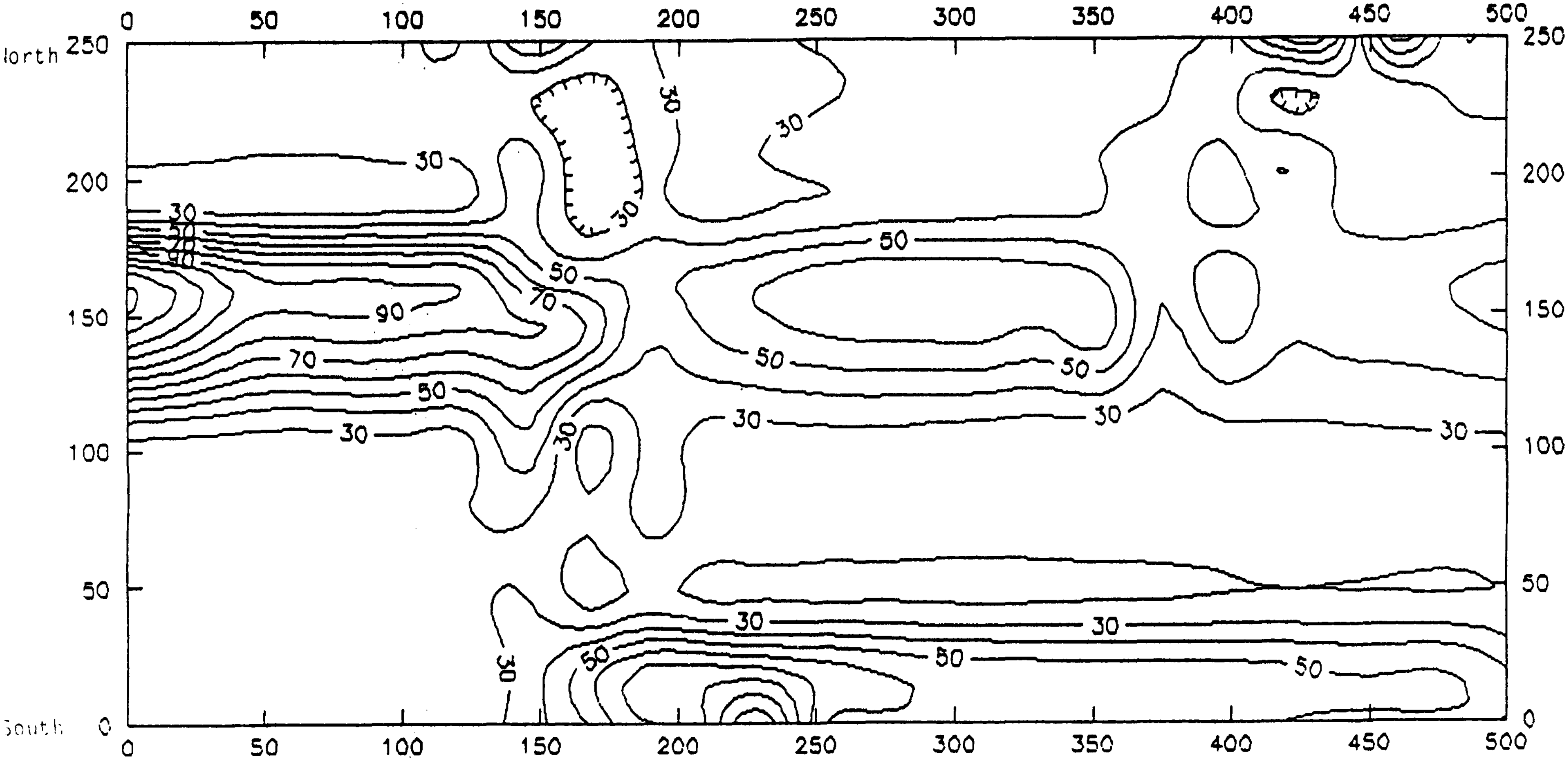
Portland ANGB East-West EM Conductivity and In-Phase Profiles



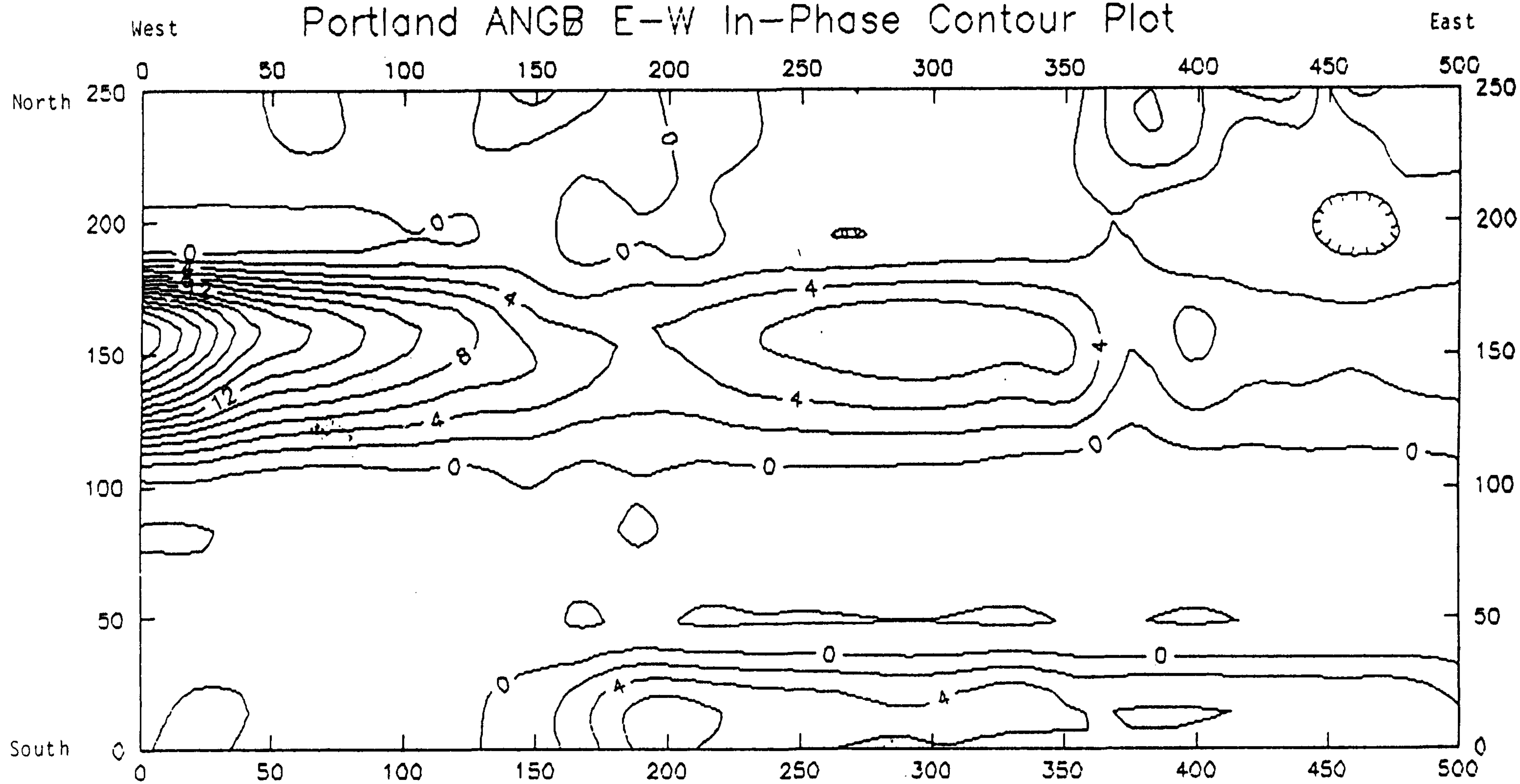
Portland ANGB East-West EM Conductivity and In-Phase Profiles



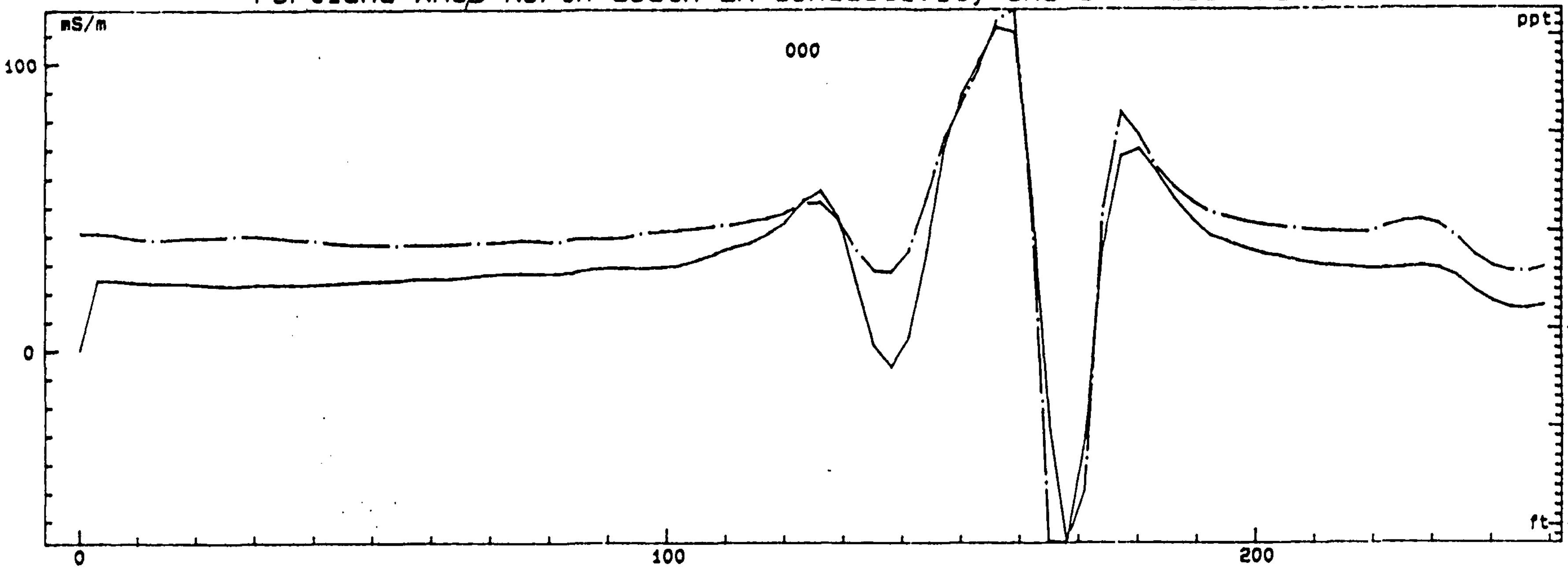
Portland ANGB E-W Conductivity Plot

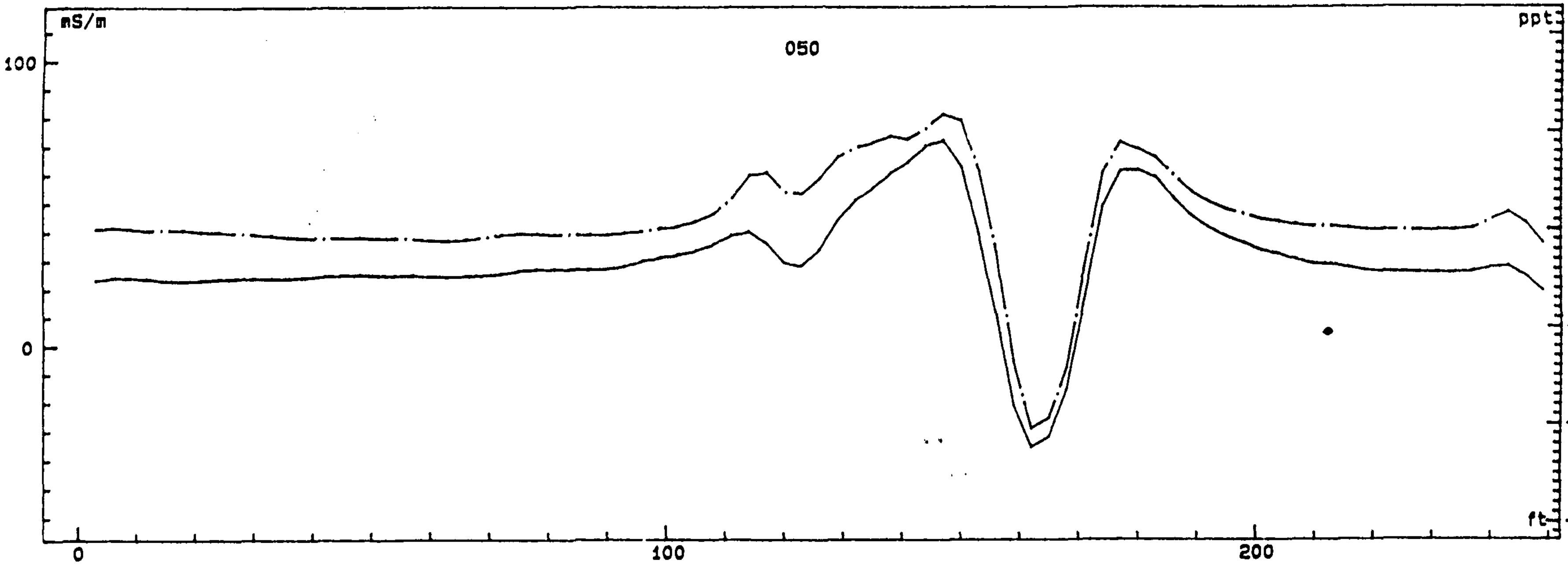


Portland ANGB E–W In–Phase Contour Plot

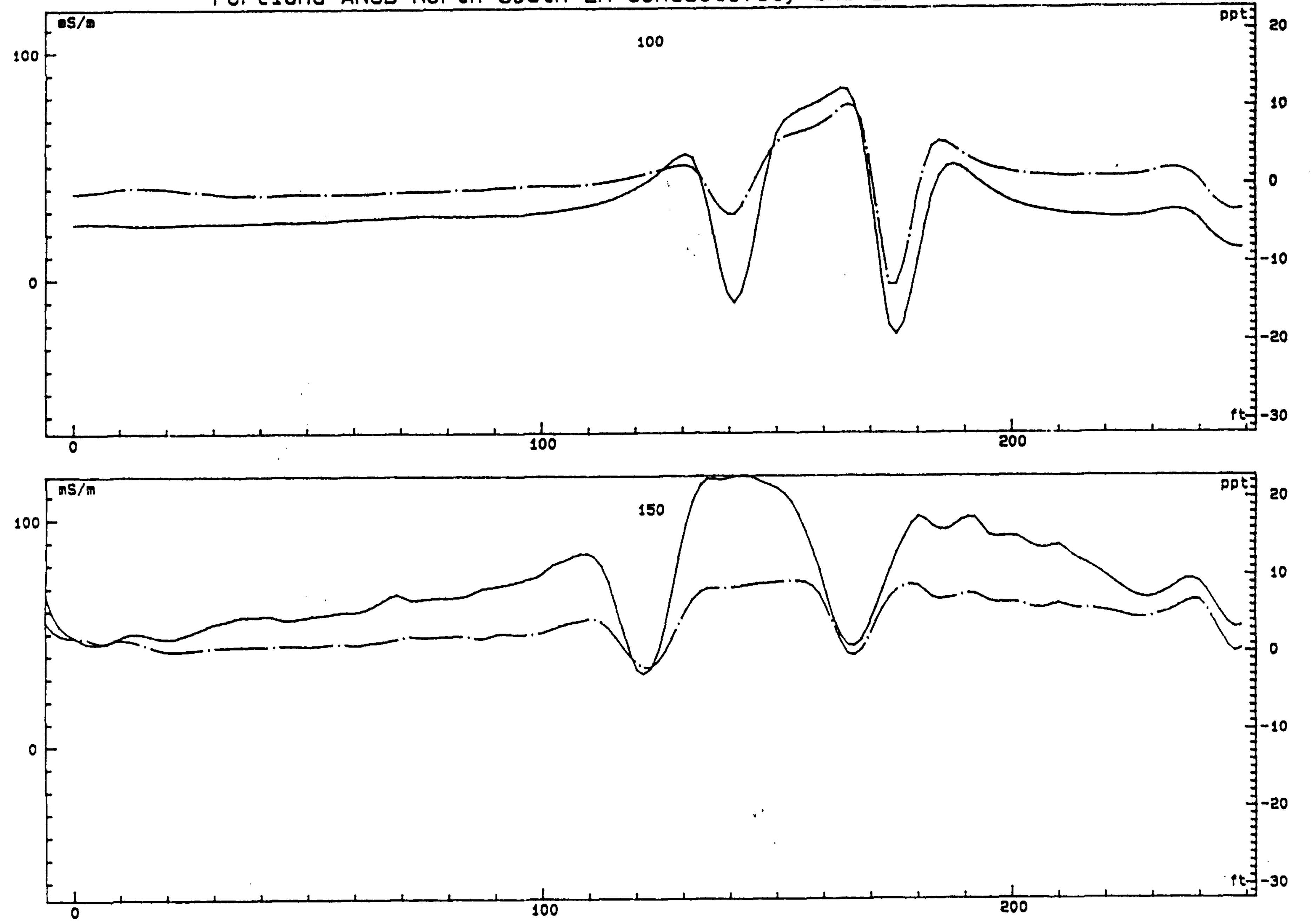


Portland ANGB North-South EM Conductivity and In-Phase Profiles

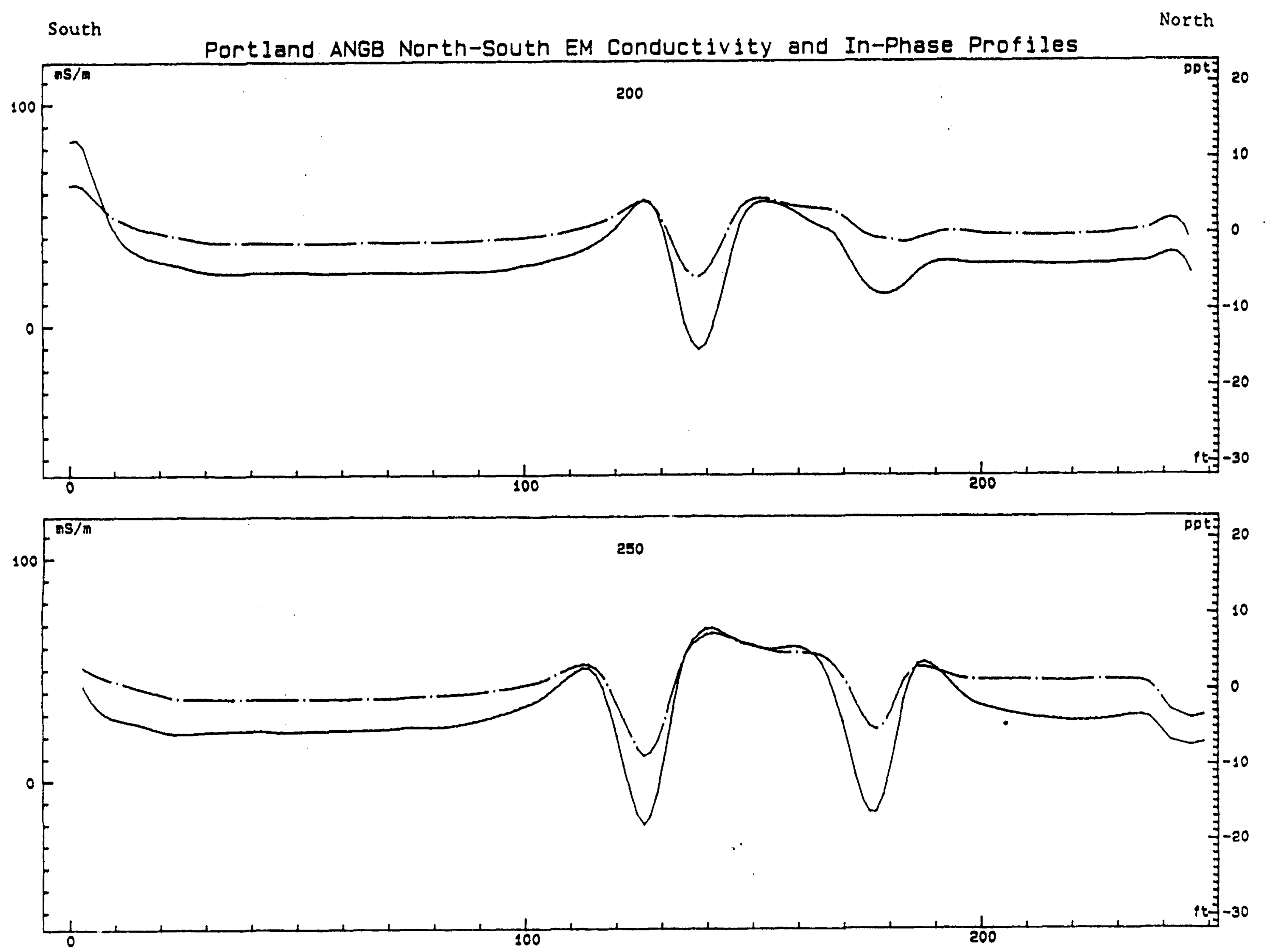




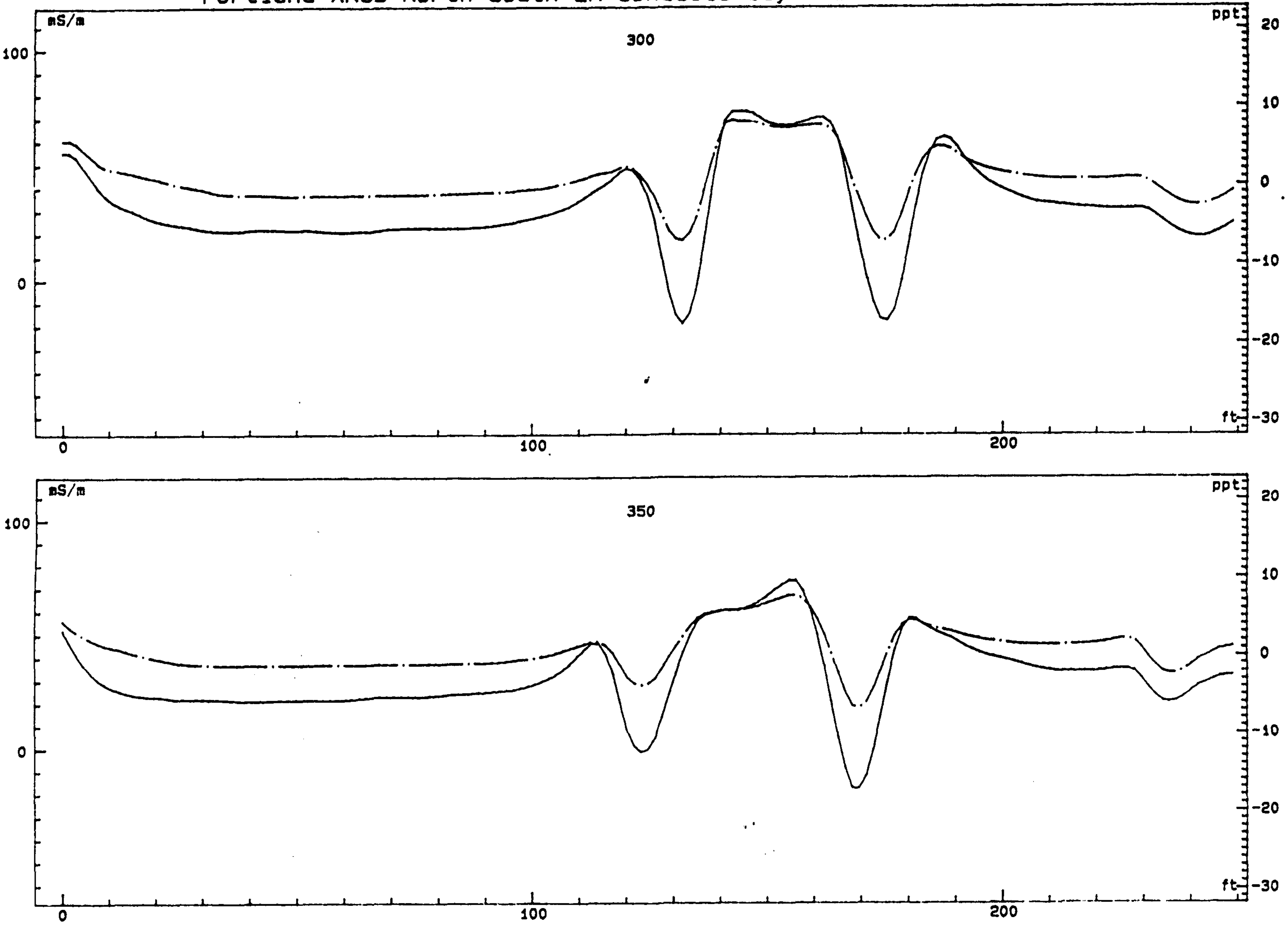
Portland ANGB North-South EM Conductivity and In-Phase Profiles



Portland ANGB North-South EM Conductivity and In-Phase Profiles

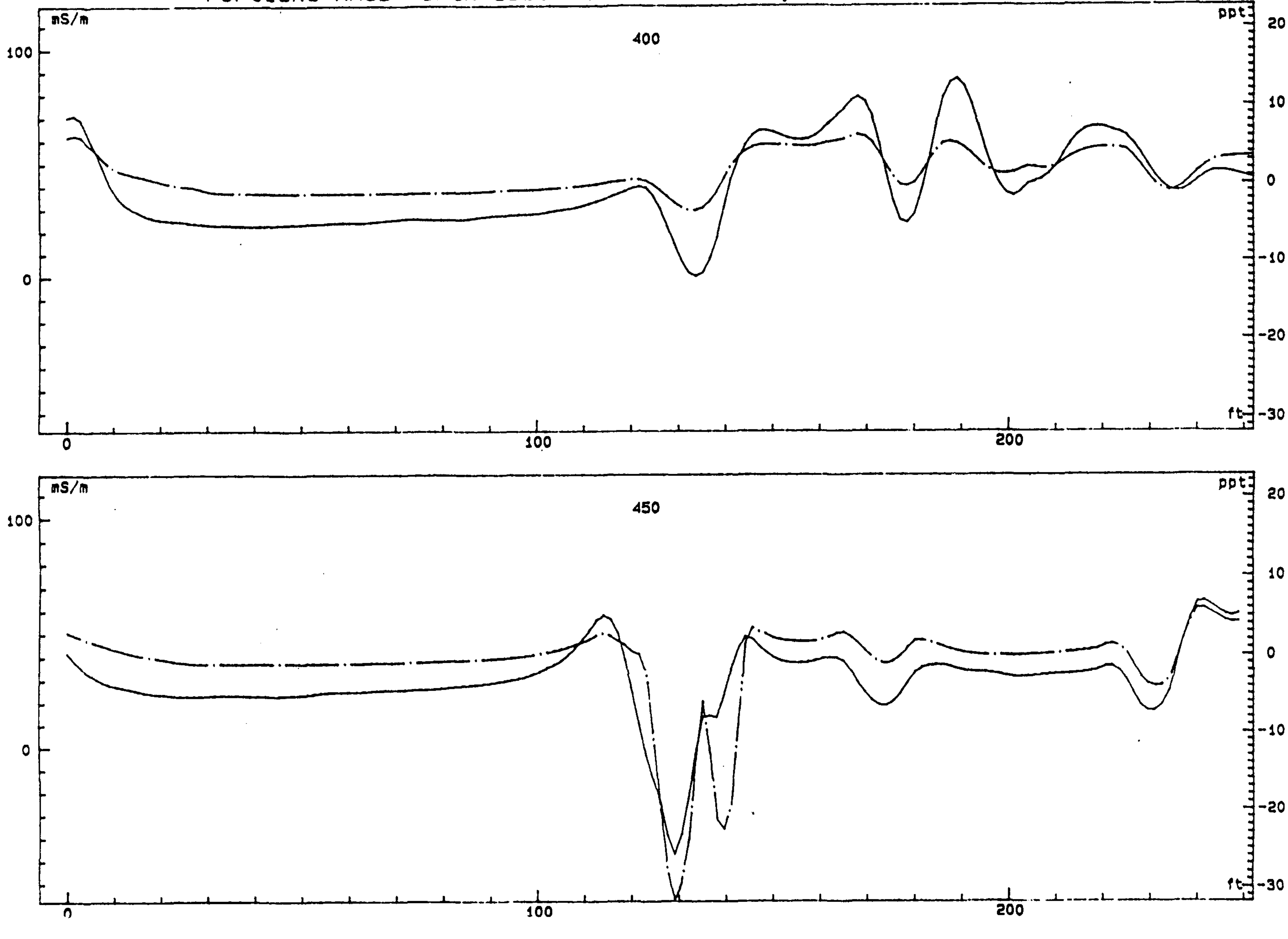


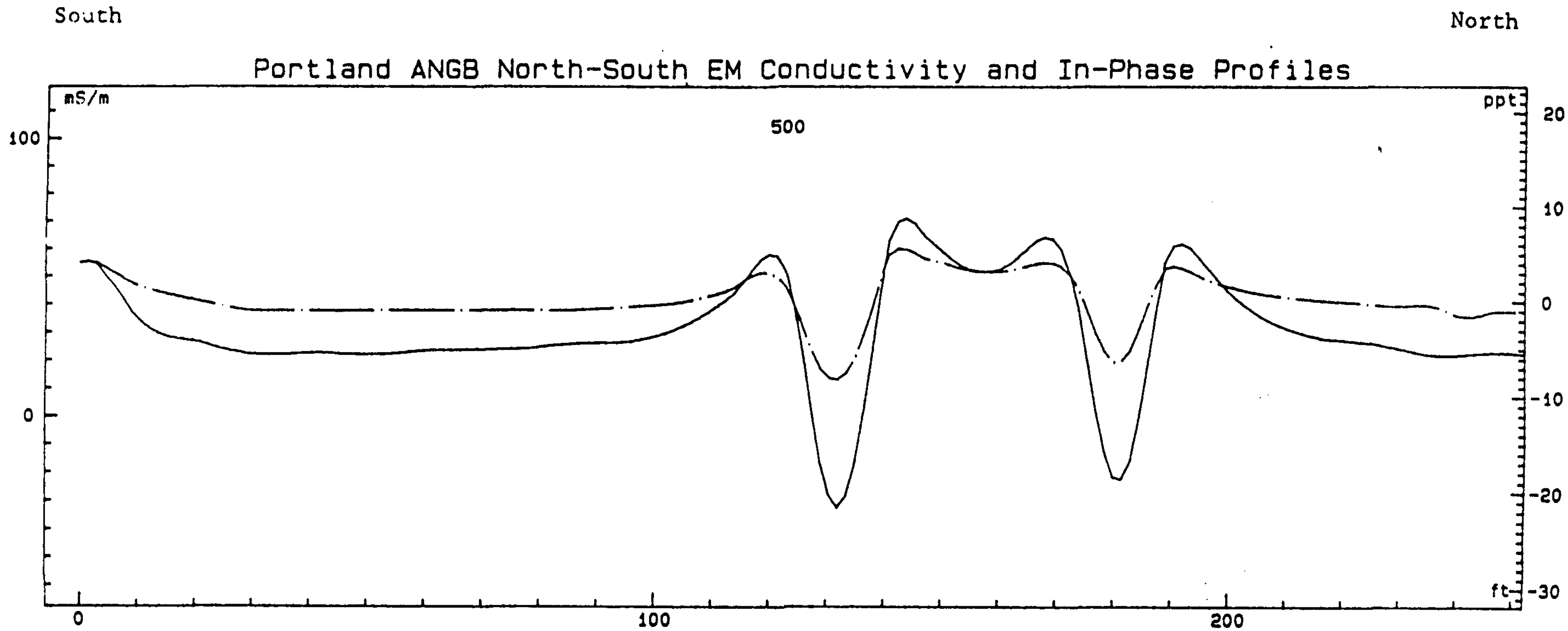
Portland ANGB North-South EM Conductivity and In-Phase Profiles



South

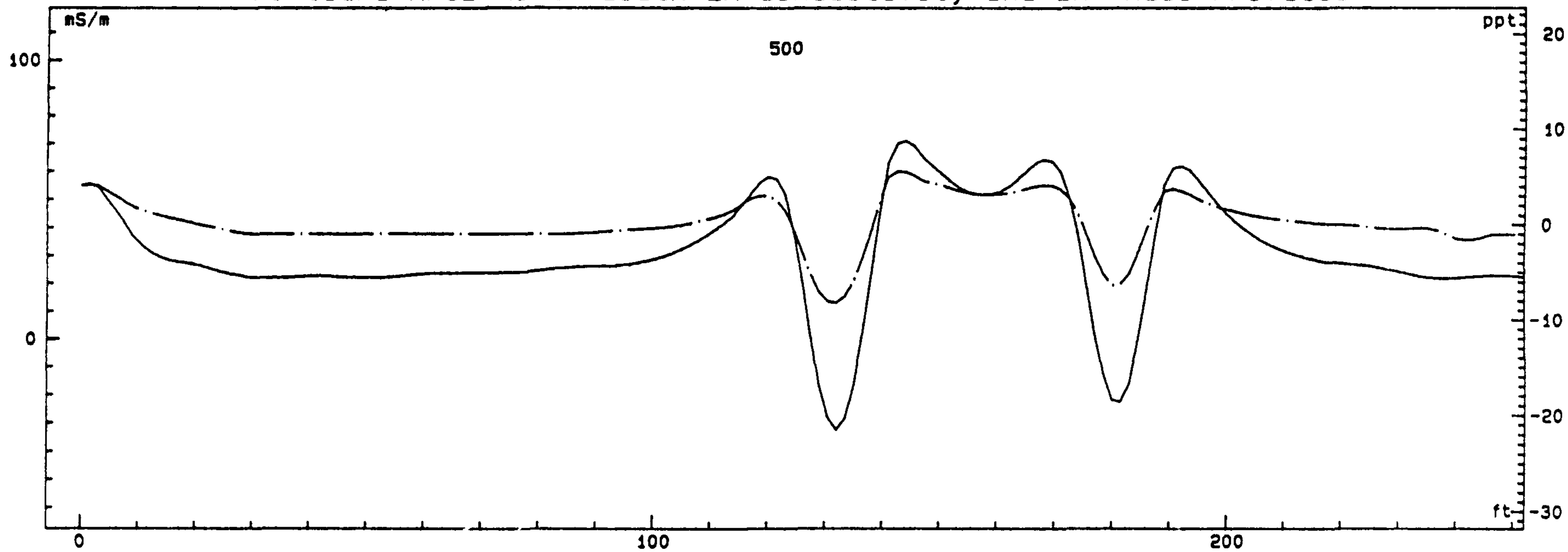
Portland ANGB North-South EM Conductivity and In-Phase Profiles



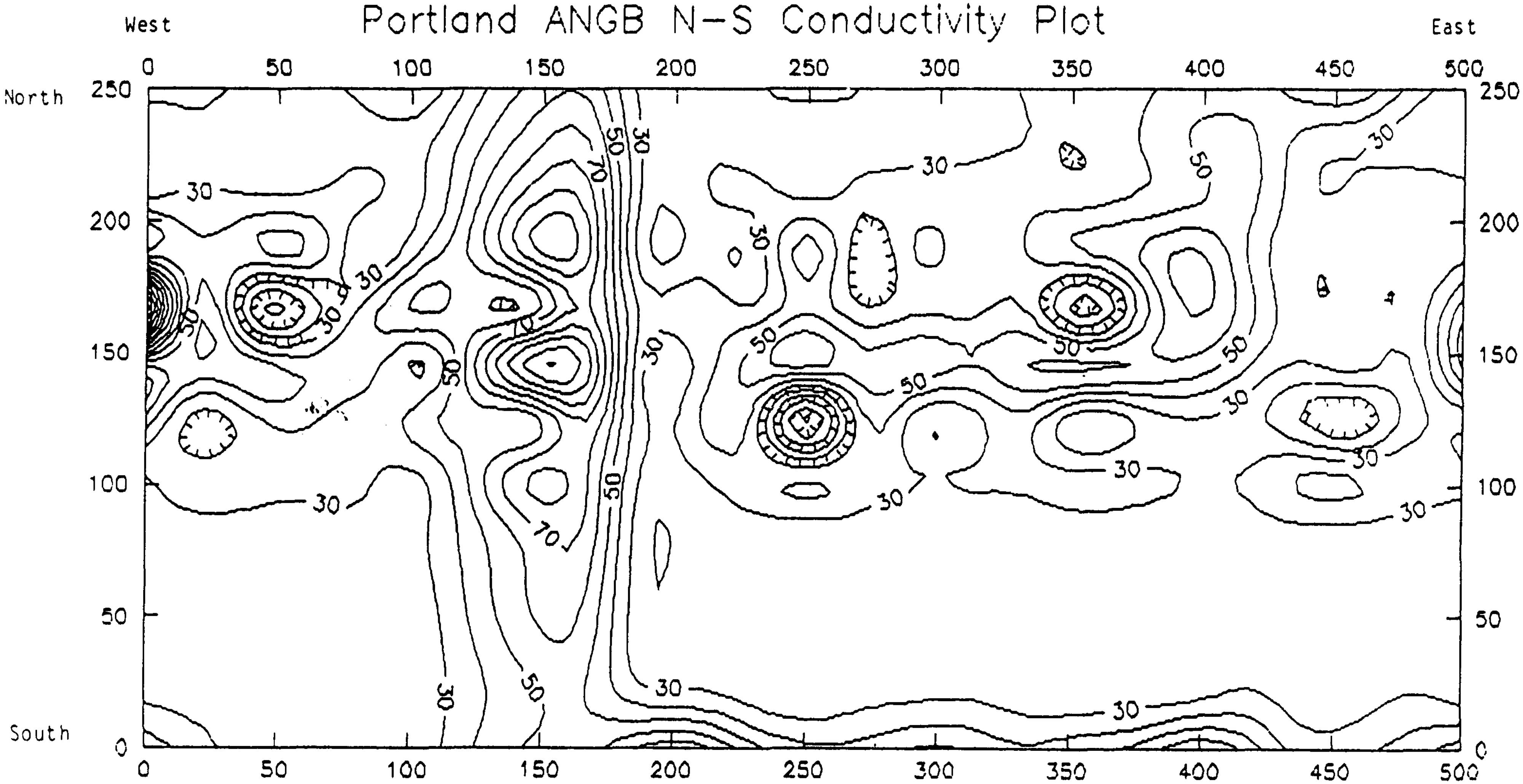


South
North
Portland ANGB North-South EM Conductivity and In-Phase Profiles
mS/m
ppt
500
100
0
20
10
0
-10
-20
ft
-30
0
100
200

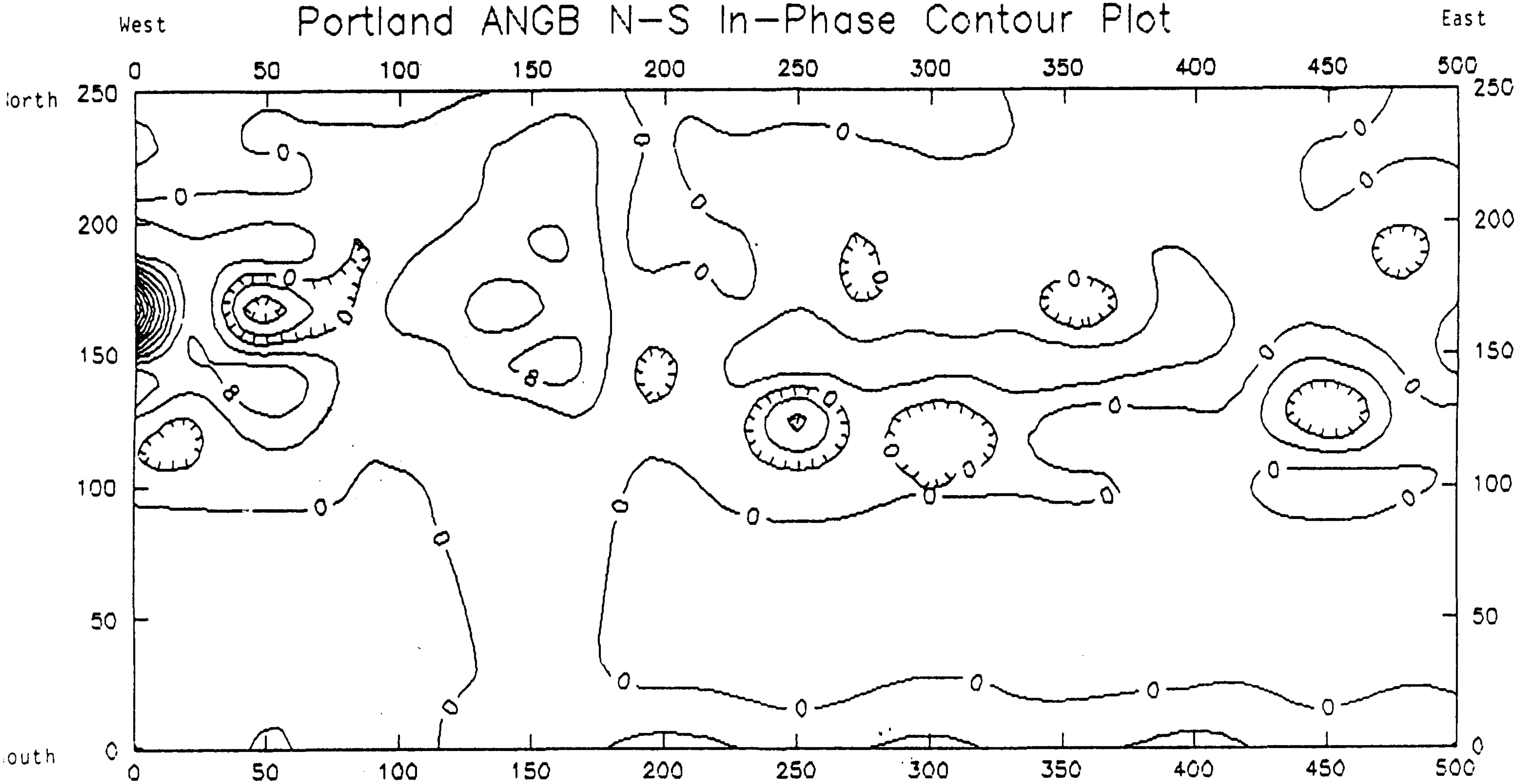
Portland ANGB North-South EM Conductivity and In-Phase Profiles



Portland ANGB N-S Conductivity Plot



Portland ANGB N-S In-Phase Contour Plot



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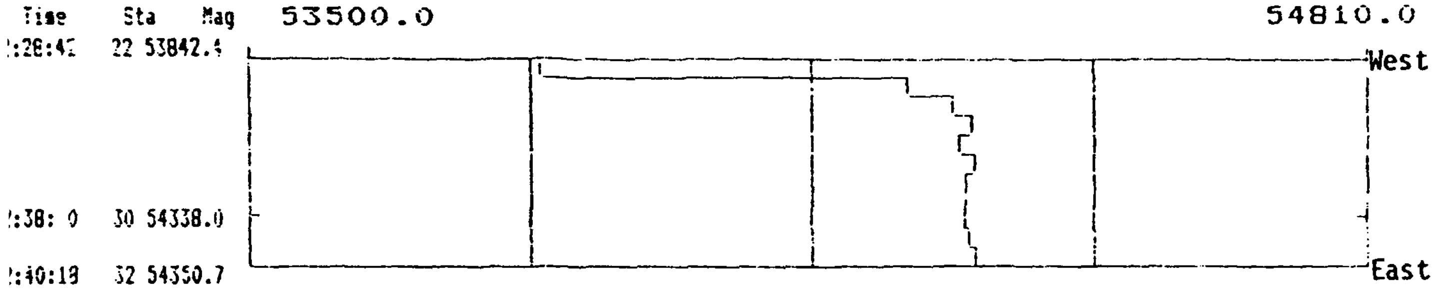

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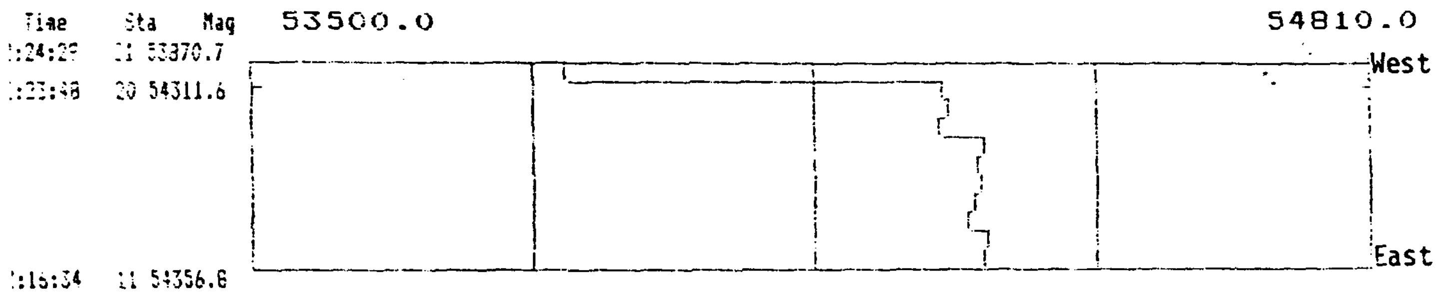

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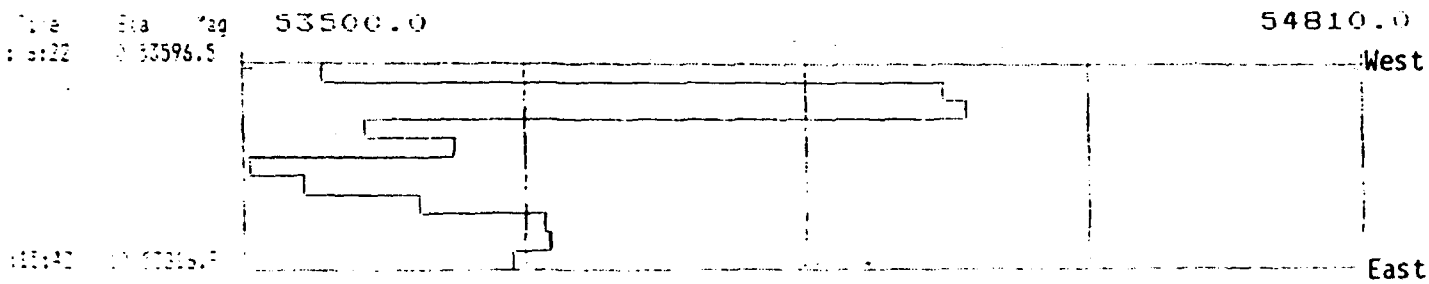

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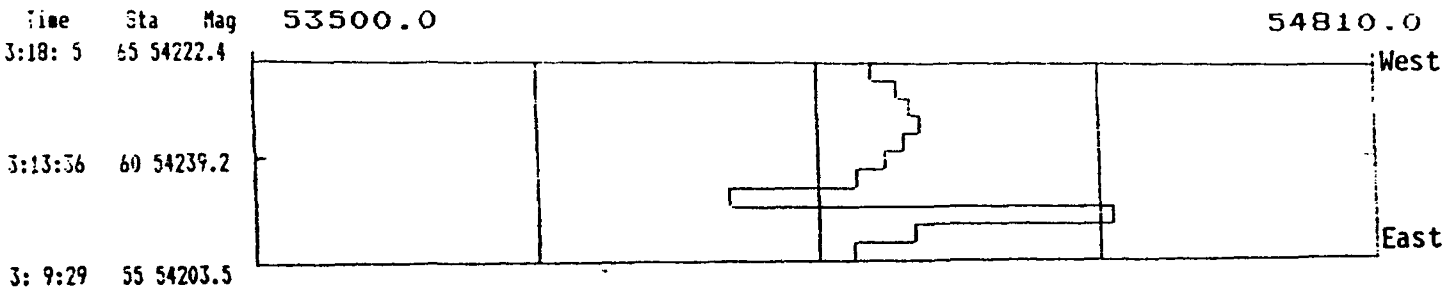

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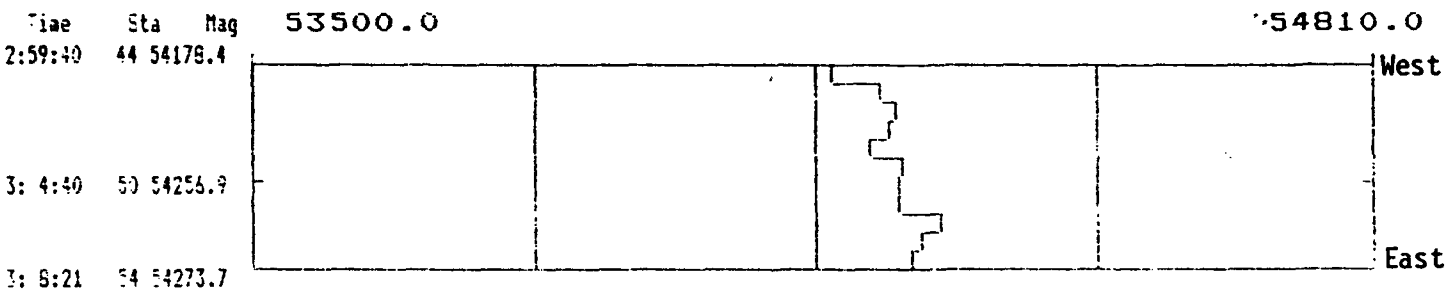

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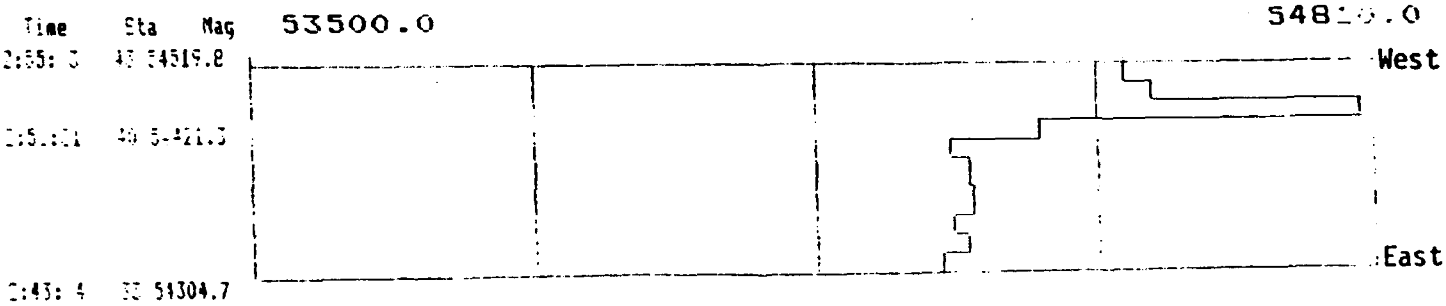
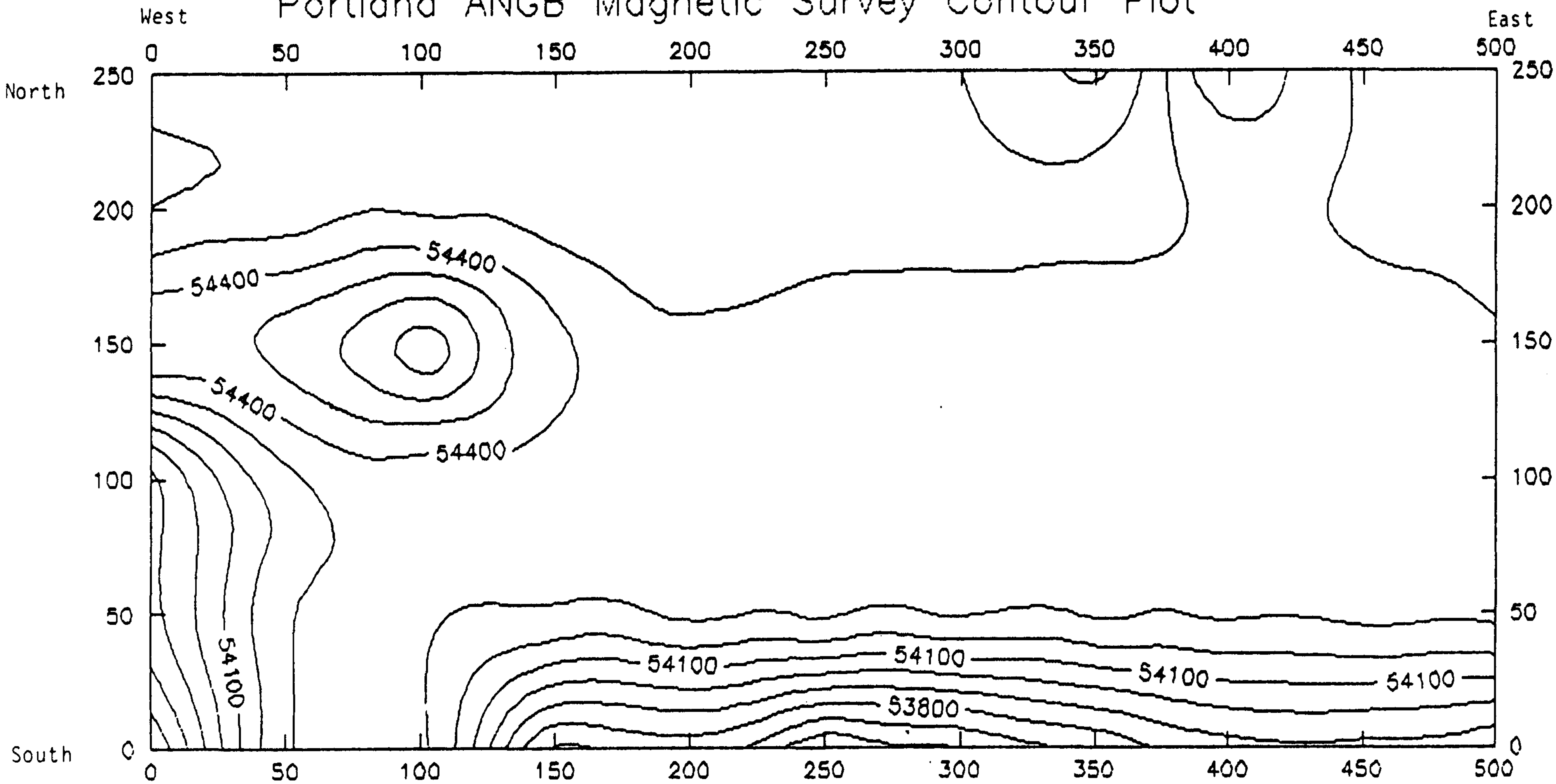


Portland ANGB Magnetic Survey Contour Plot



APPENDIX G

PUBLIC HEALTH RISK EVALUATION PROCESS

APPENDIX G

PUBLIC HEALTH RISK EVALUATION PROCESS

1.0 INTRODUCTION

Risk Assessment is an essential component of the Remedial Investigation Feasibility Study (RI/FS) process at hazardous waste sites. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP: the regulation that implements CERCLA), require that actions selected to remedy hazardous waste sites be protective of human health and the environment. An overview of risk assessment in the RI/FS process is presented in the NCP and in the EPA manual Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA 1988b). A baseline risk assessment is conducted as part of the RI to assess site conditions in the absence of remedial actions. As part of the FS process, risk assessment is used to evaluated the acceptability of proposed remedial actions and as a tool in the development of remediation objectives (target cleanup levels).

A preliminary baseline public health risk assessment has been conducted for waste sites under evaluation at ANG Portland. The public health risk assessment at ANG Portland examines the presence and release of chemicals from the sites under investigation, the observed levels of the compounds in the environment, the potential routes of exposure to human receptors, and the likelihood of adverse health effects following contact with contaminated environmental media. A detailed overview of the assessment methods used is presented in the following discussion. The focus of this evaluation is not an absolute assessment of the risks of exposure to the chemicals present at the sites under investigation. Rather, this evaluation is an assessment of the relative magnitude of anticipated health problems that may be associated with exposure to chemicals detected at the site. The intention is to determine if there is a significant threat to human health and to assess the need for further site remediation.

2.0 OVERVIEW OF METHODS

The general approach to public health risk evaluation of exposure to chemical contaminants has been well-established. The National Research Council (NRC) prepared a comprehensive overview of the structure of this assessment (NRC 1983) that has become the foundation for subsequent EPA guidance. The Human Health Evaluation Manual and the Environmental Evaluation Manual (U.S. EPA 1989a,b) provide a detailed presentation of the risk assessment process. These documents are the Agency's key guidance on risk assessment under the Superfund Program. As specified by EPA, the public health evaluation process may be divided into four fundamental component analyses: (1) data evaluation and hazard identification, (2) exposure assessment, (3) toxicity or hazard assessment, and (4) risk characterization. These analyses are briefly described in the following sections.

2.1 DATA EVALUATION AND HAZARD IDENTIFICATION

The first step in the risk assessment process is to obtain and evaluate all available data on contaminants present at the sites under investigation. The objective is to organize the data into a form appropriate for the baseline risk assessment. Once the preliminary data set has been obtained and sorted by environmental medium, the following evaluation steps should be completed:

- Evaluate the analytical methods used to determine if results are appropriate for use in quantitative risk assessment.
- Evaluate the quality of data with respect to sample quantitation and detection limits.
- Examine laboratory qualifiers assigned to monitoring data and evaluate potential QA/QC problems.
- Evaluate the quality of data with respect to blanks, and tentatively identified compounds (TICs).
- Summarize information on background concentrations of chemicals and compare with observed levels of site-related contamination.
- Identify chemicals of potential concern: develop a data set that may be appropriately used in the risk assessment process.
- If appropriate, further limit the number of chemicals to be used as the subject of the risk assessment.

From the full listing of all chemicals identified at a waste site or facility, a subset is identified that is of sufficient quality to be used in risk assessment. It may be impractical to evaluate all chemicals that have passed through QA/QC review. Representative "highest risk" compounds may be selected on the basis of: (1) quantities present at the site; (2) extent of environmental contamination, toxicity, or hazardousness; and (3) mobility and persistence of the chemical in the environment. This final step is specified as optional by EPA, and does not improve the quality or accuracy of the risk assessment. It is suggested as a device for facilitating the risk assessment process when time and resources prohibit the evaluation of the full (and often complex) data set.

2.2 EXPOSURE ASSESSMENT

2.2.1 General Approach

The objectives of the exposure assessment are to: (1) delineate exposure pathways; (2) identify receptors at risk; and (3) measure or estimate for each receptor the intensity, duration, and frequency of the exposure. Critical to the exposure assessment is a quantification of the releases of contaminants of concern to each environmental medium (from all sources at the waste site) and an assessment of the transport and transformation of the subject compounds. The results of these analyses provide data on the magnitude and extent of contamination. Both monitoring data and environmental transport modeling typically are used in the exposure assessment.

EPA has specified that actions at hazardous waste sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions (U.S. EPA 1989a). EPA defines the reasonable maximum exposure as the highest exposure that is reasonably expected to occur at a site. RMEs are estimated for individual pathways, and combined across exposure routes if appropriate.

In a public health risk assessment of hazardous waste sites, exposure pathways that may be identified include ingestion of contaminated ground water or surface water, ingestion of soil or inhalation of contaminated soil particulates, dermal contact with contaminated soil or water, and inhalation of volatile compounds. The ingestion pathway is the exposure route of primary concern in the assessment

of waste sites at ANG Portland. Dose estimates (in mg/kg/day) are developed for each chemical of concern. Estimates of dose are needed in the risk characterization and are generally determined as follows:

$$\text{Dose} = \frac{C \times CR \times EFD \times ABS}{BW \times AT}$$

Where:

C = Chemical concentration in the environmental medium under evaluation

CR = Contact rate; the amount of contaminated medium contacted per unit time or event

EFD = Exposure frequency and duration; how long and often exposuire occurs

ABS = Absorption factor

BW = Body weight; the average over the exposure period

AT = Averaging time; the period over which exposure is averaged

The equation above is used to derive estimates of subchronic or chronic dose (lifetime assumed to be 70 years). The chronic dose estimate based on mean concentrations in environmental samples (arithmetic mean) was used as the basis of the risk characterization at all sites under investigation.

2.2.2 Comparison With Applicable or Relevant and Appropriate Requirements

Once the baseline concentrations of subject chemicals have been determined at the waste sites, these levels are compared to applicable or relevant and appropriate requirements (ARARs). CERCLA of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 requires the selection of remedial actions at Superfund hazardous waste sites that are protective of human health and the environment, cost-effective, and technologically and administratively feasible. Section 121 of CERCLA specifies that response action must be undertaken in compliance with ARARs established in Federal and state environmental laws.

In the revised National Contingency Plan (NCP: 53 FR 51394) and the recently published guidance document CERCLA Compliance with Other Laws Manual (U.S. EPA 1988), several different types of requirements are identified with which

Superfund remedial actions must comply: - (1) ambient or chemical-specific requirements, (2) action-specific requirements, and (3) location-specific requirements. Because situations at CERCLA sites vary widely, EPA cannot categorically specify requirements that will be ARARs for every NPL site. ARARs can only be identified on a site-specific basis (i.e., established in connection with the characteristics of the particular site, the chemicals present at the site, and the remedial alternatives suggested by the circumstances of the site).

EPA has specified that the different ARARs that may apply to a site and its remediation should be identified and considered at several points in the remedial planning process (52 FR 32496), as delineated below:

- During scoping of the RI/FS, chemical- and location-specific ARARs may be identified on a preliminary basis.
- During the site characterization phase of the RI when the baseline public health evaluation is conducted to assess risk at a given site, the chemical-specific ARARs and advisories and location-specific ARARs are identified more comprehensively and used to help determine cleanup objectives.
- During the development of remedial alternatives in the FS, action-specific ARARs are identified for each proposed remedial alternative and are considered along with other ARARs and advisories.
- During the detailed analysis of alternatives, all ARARs for each proposed remedial action must be examined to establish the appropriate level of protection and to comply with other environmental laws.
- In selecting the most appropriate alternative, the remedial action chosen must be able to attain all ARARs, unless one of the six statutory waivers is invoked.
- During remedial design, the technical specifications of construction must comply with appropriate ARARs (primarily action-specific).

In the RI/FS process, the evaluation of remedial alternatives must consider effectiveness, implementability, and cost. Within the context of the effectiveness evaluation, chemical-specific ARARs assume major significance. Each alternative is evaluated with regard to effectiveness in protecting human health

and the environment. Effectiveness criteria include protectiveness and the envisioned reduction of toxicity, mobility, or volume through treatment.

According to the guidance presented in the revised NCP, protectiveness (i.e., the ability to protect human health and the environment) means that a given remedial alternative meets or exceeds ARARs, or other risk-based levels established through a risk assessment when ARARs do not exist or are waived. In the NCP and in the guidance manual on CERCLA compliance with other laws (53 FR 51394, U.S. EPA 1988a, 1989d), EPA specifies that when ARARs are not available for a given chemical, or where such ARARs are not sufficient to be protective, health advisory levels should be identified or developed in order to ensure that a remedy is protective.

For carcinogenic effects, these health advisory or cleanup levels are to be selected such that the total risk of all contaminants falls within the acceptable range of 10^{-4} to 10^{-7}. Although the 10^{-7} risk level is identified by EPA as a "point of departure" in evaluating the results of risk assessment, the revised NCP clearly indicates that the 10^{-4} level is the upper bound of the acceptable range (53 FR 51394). However, the 10^{-4} level is not intended as an acceptable level for deciding that a given site requires no additional investigation, but rather it may be appropriate as a cleanup level in cases where 10^{-7} levels cannot be acheived. In cases where noncarcinogenic effects are a concern, EPA specifies that cleanup should be based on acceptable levels of exposure as determined by the EPA reference doses (RfDs), taking into account the effects of multiple contaminants and multiple exposure pathways at the site.

Therefore, chemical-specific ARARs serve two primary purposes: (1) requirements that must be met by a selected remedial alternative (unless a waiver is obtained), and (2) as a basis for establishing appropriate cleanup levels. The public health risk assessment of a given remedial action alternative characterizes the actual risk of exposure of human receptors to contaminants under investigation. For carcinogens, risk characterization yields a probabilistic estimate of the additional lifetime risk of cancer in the exposed individual or the incidence of new cases of cancer in populations. For noncarcinogens, exposure levels or doses for all subject compounds are evaluated to determine levels or doses if these exceed EPA RfDs. When an ARAR is available for all

subject compounds of concern, and the ARARs are determined to be protective, these requirements become the chemical-specific cleanup goals. However, as noted above, when ARARs are found not to be protective or are not available, the results of the risk assessment (i.e., health advisory levels) are used to establish the more stringent target cleanup goals.

Thus, the requirement that a remedial alternative meet chemical-specific ARARs does not ensure that the proposed alternative is protective, and thereby potentially acceptable. This can be determined only by: (1) evaluating the combined carcinogenic risk associated with the ARAR limits for all chemicals at a given site (assuming additivity of effect in the absence of data on synergism or antagonism); (2) establishing that ARARs do not exceed U.S. EPA RfDs for noncarcinogenic effects, and are sufficiently protective when multiple chemicals are present; (3) determining whether environmental effects (in addition to human health considerations) are adequately addressed by the ARARs; and (4) evaluating whether the ARARs adequately cover all significant pathways of human exposure identified in the baseline risk assessment. The Superfund Public Health Evaluation Manual (U.S. EPA 1986c) provides guidance on evaluating multiple exposure to chemicals (carcinogenic and noncarcinogenic effects) and on establishing acceptable exposure levels when no ARARs exist.

2.3 TOXICITY ASSESSMENT

The objectives of the toxicity or hazard assessment are to evaluate the inherent toxicity of the compounds under investigation, and to identify and select toxicological measures for use in evaluating the significance of the exposure. In the development of these toxicological measures, available dose-response data are reviewed on the adverse effects to human and nonhuman receptors. Dose-response assessments for noncarcinogens provide an estimate of the no-observable-adverse-effect level (NOAEL) or lowest-observable-adverse-effect level (LOAEL). For carcinogenic compounds, the dose-response assessment yields estimates of probability or range of probabilities under which a carcinogenic effect will occur at a specified level of exposure.

In conducting an assessment of risk of exposure to chemicals released from waste sites, several toxicity measures of importance may be identified:

- RfDs for oral exposure - acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)

- RfDs for inhalation exposure - acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)

- Carcinogenic potency factors for oral exposure

- Carcinogenic potency factors for inhalation exposure

The RfDs and potency factors for oral exposure are the toxicity measures needed in the assessment for ANG Portland. Long-term (i.e., chronic) exposure and health risk is the focus of the evaluation at all sites.

The primary sources of information for these data is the Integrated Risk Information System (IRIS) data base. IRIS is a computer-housed catalog of EPA risk assessment and risk management information for chemical substances. Data in the IRIS system is regularly reviewed and updated monthly. If toxicity measures are not available on IRIS, EPA recommends use of the EPA ORD Health Effects Assessment Summary Tables (HEAST: FY 1989. U.S. EPA, 1989c) as the second most current source of information. SAIC has on-line access to the IRIS Data Base and receives the quarterly HEAST publications from EPA ORD. Therefore, the risk assessment is based on the most up-to-date EPA-approved toxicity measures available for waste site evaluation.

A summary of the toxicity measures used in the evaluation of the waste sites at ANG Portland is presented in the section on risk assessment. A list is provided of RfDs (chronic and subchronic when available), carcinogenic potency factors (oral and inhalation routes), weight of evidence ratings, and sources of information.

2.4 RISK CHARACTERIZATION

The last step in the baseline public health evaluation is risk characterization. This is the process of integrating the results of the exposure and hazard (toxicity) assessment (i.e., of comparing estimates of dose with appropriate toxicological endpoints to determine the likelihood of adverse effects in exposed populations). It is common practice to consider risk characterization separately for carcinogenic and noncarcinogenic effects. This is due to a fundamental

difference in the way organisms typically respond following exposure to carcinogenic or noncarcinogenic agents. For noncarcinogenic effects, toxicologists recognize the existence of a threshold of exposure below which there is only a very small likelihood of adverse health impacts in an exposed individual. Exposure to carcinogenic compounds, however, is not thought to be characterized by the existence of a threshold. Rather, all levels of exposure are considered to carry a risk of adverse effect.

The procedure for calculating risk associated with exposure to carcinogenic compounds has been established by EPA (U.S. EPA, 1986b,c; U.S. EPA, 1989a). A non-threshold, dose-response model is used to calculate a carcinogenic potency factor (which mathematically is the slope of the dose-response curve) for each chemical. To derive an estimate of risk, the carcinogenic potency factor (q_1* - defined below) is then multiplied by the estimated chronic daily dose experienced by the exposed individual:

$$\text{Risk} = \text{CDI} \times q_1^*$$

Where:

Risk = Upper bound estimate of the excess lifetime cancer risk to an individual (unitless probability)

CDI = Chronic daily dose averaged over a 70 year period (mg/kg body weight/day)

q_1* = 95% upper-bound estimate of the slope of the dose-response curve $(\text{mg/kg body weight/day})^{-1}$

The slope factor q_1^* is used to convert estimates of daily intake or dose averaged over a lifetime, to incremental excess risk of an individual developing cancer. EPA notes that use of this equation assumes that the dose-response relationship is linear in the low-dose portion of the multistage model dose-response curve (U.S. EPA 1989a: A linearized multistage dose response model is most commonly used by EPA in deriving the slope estimates.) Given this assumption, the slope factor is a constant and risk is directly proportional to intake.

EPA indicates that use of the linear equation (above) for risk estimation is valid only at risk levels $<1 \times 10^{-2}$. The Agency recommends use of the following

equation (based on the "one-hit" model of carcinogenesis) as an alternative at sites where exposure and intakes are projected to be quite high, and risk levels may exceed 1×10^{-2}.

$$\text{Risk} = 1 - \exp(-\text{CDI} \times q_1^*)$$

In evaluating risk of exposure to more than one carcinogen, the risk measure for each compound may be summed (in the absence of information on antagonistic or synergistic effects) to provide an overall estimate of total carcinogenic risk (U.S. EPA 1989a).

$$\text{Risk}_T = \sum_{i=1}^{n} \text{Risk}_i$$

Where:

Risk_T = The combined excess lifetime cancer risk across chemical carcinogens

Risk_i = The risk estimate for the i^{th} chemical of n chemicals under evaluation

This is conducted for each source of environmental release, associated exposure pathway, and receptor group at risk of exposure. Population risks are derived by multiplying the overall risk level (summed for all subject chemicals) by the number of people exposed. This would yield a measure of the additional incidence of developing cancer (i.e., additional number of new cases) in the exposed population over a lifetime (i.e., 70 years) of exposure.

The traditionally accepted practice of evaluating exposure to noncarcinogenic compounds has been to experimentally determine a NOAEL and to divide this by a safety factor to establish an acceptable human dose, for example, acceptable daily intake or RfD (NRC 1983). The RfD is then compared to the average daily dose experienced by the exposed population to obtain a measure of concern for adverse noncarcinogenic effects:

$$HQ = Dose/RfD$$

Where:

HQ - Hazard Quotient: potential for adverse noncarcinogenic effects

Dose - Average daily dose for subchronic or chronic exposure (mg/kg body weight/day)

RfD - Acceptable intake for subchronic or chronic exposure (mg/kg body weight/day)

Dose and the RfD are expressed in the same units and are based upon common exposure periods (i.e., chronic, subchronic, or shorter-term). If HQ is >1, then there may be potential for adverse noncarcinogenic effects at the given exposure/dose level. Guidelines for evaluating exposure to mixtures of non-carcinogens is presented by EPA (U.S. EPA 1986b, U.S. EPA 1989a). Essentially, this involves summing the hazard quotient (ratios of daily dose/RfD) for all chemicals under evaluation. If the sum of these ratios, called the Hazard Index (HI) is >1, then there is the potential for adverse noncarcinogenic effects. Under these circumstances, EPA recommends segregating the compounds into groups of like or common toxicological effects, and again to evaluate the potential for manifestation of the various adverse health effects identified.

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APPENDIX H

HAZARD RANKING SYSTEM SCORE SHEETS

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If observed release is given a score of 45, proceed to line 4 If observed release is given a score of 0, proceed to line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	-
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			32,490	57,330	
7 Divide line 6 by 57,330 and multiply by 100		S_{gw} = 56.7			

GROUND WATER ROUTE WORK SHEET

For Site 1, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	6	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	2	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
	Total Targets Score		8	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			5,472	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} = 8.5				

SURFACE WATER ROUTE WORK SHEET

For Site 1, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	56.7	3,215
Surface Water Route Score (S_{sw})	8.5	72
Air Route Score (S_a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		3,287
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		57.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		33.1

WORKSHEET FOR COMPUTING S_M

For Site 1, Portland Air National Guard

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	45	45	3.1
If observed release is given a score of 45, proceed to line 4 If observed release is given a score of 0, proceed to line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			32,490	57,330	
7 Divide line 6 by 57,330 and multiply by 100		S_{gw} =	56.7		

GROUND WATER ROUTE WORK SHEET

For Site 2, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	6	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	2	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1		40	
	Total Targets Score		8	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			5,472	64,350	
7 Divide line 6 by 64,350 and multiply by 100		S_{sw} =	8.5		

SURFACE WATER ROUTE WORK SHEET

For Site 2, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	56.7	3,215
Surface Water Route Score (S_{sw})	8.5	72
Air Route Score (S_a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		3,287
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		57.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} \,/\, 1.73 = S_M =$		33.1

WORKSHEET FOR COMPUTING S_M

For Site 2, Portland Air National Guard

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceed to line [4] If observed release is given a score of 0, proceed to line [2]					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	6	6	
Net Precipitation	0 1 2 3	1	2	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	1	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	-
[3] Containment	0 1 2 3	1	3	3	3.3
[4] Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	12	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		13	26	
[5] Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
[6] If line [1] is 45, multiply [1] x [4] x [5] If line [1] is 0, multiply [2] x [3] x [4] x [5]			17,784	57,330	
[7] Divide line [6] by 57,330 and multiply by 100	S_{gw} = 31.0				

GROUND WATER ROUTE WORK SHEET

For Site 3, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	2	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		8	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	12	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		13	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2		6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
	Total Targets Score		6	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			1,872	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} = 2.9				

SURFACE WATER ROUTE WORK SHEET

For Site 3, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	31.0	961
Surface Water Route Score (S_{sw})	2.9	8
Air Route Score (S_a)	0	0
$S^2_{gw} + S^2_{sw} + S^2_a$		969
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a}$		31.1
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a} / 1.73 = S_M =$		18.0

WORKSHEET FOR COMPUTING S_M

For Site 3, Portland Air National Guard

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceed to line 4 If observed release is given a score of 0, proceed to line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	6	6	
Net Precipitation	0 1 2 3	1	2	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	1	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	-
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	12	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		13	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			17,784	57,330	
7 Divide line 6 by 57,330 and multiply by 100	S_{gw} = 31.0				

GROUND WATER ROUTE WORK SHEET

For Site 4, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	4	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		10	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	12	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		13	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	2	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1		40	
	Total Targets Score		8	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			3,120	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} = 4.8				

SURFACE WATER ROUTE WORK SHEET

For Site 4, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	31.0	961
Surface Water Route Score (S_{sw})	4.8	34
Air Route Score (S_a)	0	
$S^2_{gw} + S^2_{sw} + S^2_a$		995
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a}$		31.5
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a} / 1.73 = S_M =$		18.2

WORKSHEET FOR COMPUTING S_M

For Site 4, Portland Air National Guard

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceed to line 4 If observed release is given a score of 0, proceed to line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	6	6	
Net Precipitation	0 1 2 3	1	2	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	1	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	-
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			25,992	57,330	
7 Divide line 6 by 57,330 and multiply by 100		S_{gw} = 45.33			

GROUND WATER ROUTE WORK SHEET

For Site 5, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	4	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		10	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	0	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
	Total Targets Score		6	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			3,420	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} = 5.3				

SURFACE WATER ROUTE WORK SHEET

For Site 5, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	45.3	2,052
Surface Water Route Score (S_{sw})	5.3	28
Air Route Score (S_a)	0	0
$S^2_{gw} + S^2_{sw} + S^2_a$		2,080
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a}$		456
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a} / 1.73 = S_M =$		26.4

WORKSHEET FOR COMPUTING S_M

For Site 5, Portland Air National Guard

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	3.1
If observed release is given a score of 45, proceed to line 4 If observed release is given a score of 0, proceed to line 2					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2	6	6	
Net Precipitation	0 1 2 3	1	2	3	
Permeability of the Unsaturated Zone	0 1 2 3	1	1	3	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	-
3 Containment	0 1 2 3	1	3	3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	15	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		16	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	32	40	
	Total Targets Score		38	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			21,888	57,330	
7 Divide line 6 by 57,330 and multiply by 100		S_{gw} =	38.2		

GROUND WATER ROUTE WORK SHEET

For Site 7, Portland Air National Guard

Surface Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multiplier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4 If observed release is given a value of 0, proceed to line 2					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	3	3	
Distance to Nearest Surface Water	0 1 2 3	2	6	6	
Physical State	0 1 2 3	1	3	3	
	Total Route Characteristics Score		12	15	
3 Containment	0 1 2 3	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	15	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		16	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	2	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
	Total Targets Score		8	55	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			4,608	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} =		7.2		

SURFACE WATER ROUTE WORK SHEET

For Site 7, Portland Air National Guard

	S	S^2
Groundwater Route Score (S_{gw})	38.2	1,459
Surface Water Route Score (S_{sw})	7.2	52
Air Route Score (S_a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		1,511
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		38.9
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		22.5

WORKSHEET FOR COMPUTING S_M

For Site 7, Portland Air National Guard

ANG PORTLAND HRS SCORING

SITE 1

Ground Water Route

Release

Observed Release	Score = 45	(Site Investigation Project Management Plan Fast-Track Memo)

Waste Characteristics

Toxicity/Persistence	Score = 18	(Methylene Chloride, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988)
Distance to Wells	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Aquifer Route Score = 56.7

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

SITE 1 (cont'd)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body: Columbia Slough)
1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Surface Water	Score = 3	(900 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, documented release and HMTC Phase 1 Records Search)
Containment	Score = 3	(Leaking containers with no surface containment to prevent runoff, HMTC Phase 1 Records Search)

Waste Characteristics

Toxicity/Persistence	Score = 18	(Methylene Chloride, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)

SITE 1 (cont'd)

Distance to Sensitive Environment	Score = 1	(Fresh water wetland <1 mile west of the site, SI Project Management Plan)
Population Served Distance to Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

Surface Water Route Score = 8.5

Air Route

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

MIGRATION SCORES FOR SITE 1

Ground Water Score (S_{gw}) = 56.7

Surface Water Score (S_{sw}) = 8.5

Air Score (S_a) = 0

Migration Score (S_M) = 33.1

ANG PORTLAND HRS SCORING

SITE 2

Ground Water Route

Release

Observed Release	Score = 45	(Site Investigation Project Plan, Table 5, SI Project Management Plan Fast-Track Memo)

Waste Characteristics

Toxicity/Persistence	Score = 18	(Trans-1,2-dichloroethene, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988
Distance to Wells/ Population Served	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Aquifer Route Score = 56.7

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

SITE 2 (cont'd)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body - Columbia Slough)
1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Surface Water	Score = 3	(950 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, documented release and HMTC Phase 1 Records Search)
Containment	Score = 3	(Leaking containers with no surface containment to prevent runoff, HMTC Phase 1 Records Search)

Waste Characteristics

Toxicity/Persistence	Score = 18	(Trans-1,2-dichloroethene, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)

SITE 2 (cont'd)

Distance to Sensitive Environment	Score = 1	(Fresh water wetland <1 mile west of the site, SI Project Management Plan)
Population Served Distance to Surface Water Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

Surface Water Route Score = 8.5

Air Route

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

MIGRATION SCORES FOR SITE 2

Ground Water Score (S_{gw}) = 56.7

Surface Water Score (S_{sw}) = 8.5

Air Score (S_a) = 0

Migration Score (S_M) = 33.1

ANG PORTLAND HRS SCORING

SITE 3

<u>Ground Water Route</u>

Release

Observed Release	Score = 0	(Site Investigation results, this report)
Waste Characteristics		
Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, with documented presence due to presence of petroleum fuel/oil, HMTC Phase I Records Search)
Route Characteristics		
Depth to Aquifer	Score = 3	(Depth of 8 feet from surface to top of aquifer)
Unsaturated Zone Permeability	Score = 1	(Silt and silty clay encountered in MW3-1, SI Project Management Plan)
Net Precipitation	Score = 2	(Lake Evaporation = 24" (HRS map); Annual Precipitation = 39" (Monthly Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1951-1980. Oregon. NOAA Environmental Data and Information Service, National Climatic Center, Asheville, NC)
Physical State	Score = 3	(Liquid substances were stored and spilled at the site, HMTC Phase 1 Records Search)
Containment	Score = 3	(Fuel spilled from engine test facility, no liner present, HMTC Phase 1 Records Search, SI Project Management Plan)

SITE 3 (cont'd)

Waste Characteristics

Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988)
Distance to Wells/ Population Served	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Aquifer Route Score = 31.0

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body - Columbia Slough)

SITE 3 (cont'd)

1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Surface Water	Score = 1	(4500 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, SI soil gas survey, HMTC Phase 1 Records Search)
Containment	Score = 3	(Spill with no surface containment to prevent runoff, HMTC Phase 1 Records Search)
Waste Characteristics		
Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)
Targets		
Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)
Distance to Sensitive Environment	Score = 0	(Fresh water wetland >1 mile west of the site, SI Project Management Plan)
Population Served/ Distance to Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

SITE 3 (cont'd)

Surface Water Route Score = 2.9

Air Route

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

MIGRATION SCORES FOR SITE 3

Ground Water Score (S_{gw}) = 31.0

Surface Water Score (S_{sw}) = 2.9

Air Score (S_a) = 0

Migration Score (S_M) = 18.0

ANG PORTLAND HRS SCORING

SITE 4

<u>Ground Water Route</u>

Release

Observed Release	Score = 0	(Site Investigation results, this report)

Waste Characteristics

Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, with documented presence due to presence of petroleum fuel/oil HMTC Phase I Records Search)

Targets

Ground Water Use	*Score* = 0	(Well yields of 0.5 gpm or less, SI field efforts)
Distance to Wells/ Population Served	Score = 0	(Well records of USGS, Portland; no wells screened in floodplain materials)

Route Characteristics

Depth to Aquifer	Score = 3	(Depth of 8 feet from surface to top of aquifer)
Unsaturated Zone Permeability	Score = 1	(Silt and silty clay encountered in MW3-1, SI Project Management Plan)
Net Precipitation	Score = 2	(Lake Evaporation = 24" (HRS map); Annual Precipitation = 39" (Monthly Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1951-1980. Oregon. NOAA Environmental Data and Information Service, National Climatic Center, Asheville, NC)

SITE 4 (cont'd)

Physical State	Score = 3	(Liquid substances were stored and spilled at the site, HMTC Phase 1 Records Search)
Containment	Score = 3	(Fuel spilled from runway apron, no liner present, HMTC Phase 1 Records Search, SI Project Management Plan)
Waste Characteristics		
Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)
Targets		
Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988)
Distance to Wells/ Population Served	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Aquifer Route Score = 31.0

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

SITE 4 (cont'd)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body - Columbia Slough)
1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Surface Water	Score = 2	(2000 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, SI soil gas survey, HMTC Phase 1 Records Search)
Containment	Score = 3	(Spill with no surface containment to prevent runoff, HMTC Phase 1 Records Search)

Waste Characteristics

Toxicity/Persistence	Score = 12	(Straight chain hydrocarbons, Toxicity Class 3, Persistence Class 2 from HRS Manual p. 20, Table 4)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)

SITE 4 (cont'd)

Distance to Sensitive Environment	Score = 1	(Fresh water wetland <1 mile west of the site, SI Project Management Plan)
Population Served/ Distance to Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

Surface Water Route Score = 4.8

Air Route

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

MIGRATION SCORES FOR SITE 4

Ground Water Score (S_{gw}) = 31.0

Surface Water Score (S_{sw}) = 4.8

Air Score (S_a) = 0

Migration Score (S_M) = 18.2

ANG PORTLAND HRS SCORING

SITE 5

Ground Water Route

Release

Observed Release	Score = 0	(Site Investigation Project Plan, Table 7, SI Project Management Plan Fast-Track Memo)

Targets

Ground Water Use	Score = 0	(Well yields of 0.5 gpm or less, SI field efforts)
Distance to Wells/ Population Served	Score = 0	(Well records of USGS, Portland; no wells screened in floodplain materials)

Route Characteristics

Depth to Aquifer	Score = 3	(Depth of 6 feet from surface to top of aquifer)
Unsaturated Zone Permeability	Score = 1	(Silt and silty clay encountered in MW5-1, SI Project Management Plan)
Net Precipitation	Score = 2	(Lake Evaporation = 24" (HRS map); Annual Precipitation = 39" (Monthly Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1951-1980. Oregon. NOAA Environmental Data and Information Service, National Climatic Center, Asheville, NC)
Physical State	Score = 3	(Liquid substances were stored and spilled at the site, HMTC Phase 1 Records Search)
Containment	Score = 3	(Leaking Containers, no liner present, HMTC Phase 1 Records Search, SI Project Management Plan)

SITE 5 (cont'd)

Waste Characteristics

Toxicity/Persistence	Score = 18	(Lead, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

Targets

Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988)
Distance to Wells/ Population Served	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Aquifer Route Score = 45.3

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body - Columbia Slough)

ANG PORTLAND HRS SCORING

SITE 5 (cont'd)

1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Surface Water	Score = 2	(1000 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, documented release and HMTC Phase 1 Records Search)
Containment	Score = 3	(Leaking containers with no surface containment to prevent runoff, HMTC Phase 1 Records Search)
Waste Characteristics		
Toxicity/Persistence	Score = 18	(Lead, Toxicity Class 3 from Sax, Persistence Class 3 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)
Targets		
Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)
Distance to Sensitive Environment	Score = 0	(Fresh water wetland <1 mile west of the site, SI Project Management Plan)
Population Served/ Distance to Surface Water Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

SITE 5 (cont'd)

Surface Water Route Score - 5.3

Air Route

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

MIGRATION SCORES FOR SITE 5

Ground Water Score (S_{gw}) - 45.3

Surface Water Score (S_{sw}) - 5.3

Air Score (S_a) - 0

Migration Score (S_M) - 26.4

SITE 7

Ground Water Route

Release

No Release	Score = 0	(Site Investigation results)
Route Characteristics		
Depth to Aquifer	Score = 3	(Depth of 9 feet from surface to top of aquifer)
Unsaturated Zone Permeability	Score = 1	(Silt and silty clay encountered in MW5-1, SI Project Management Plan)
Net Precipitation	Score = 2	(Lake Evaporation = 24" (HRS map); Annual Precipitation = 39" (Monthly Normals of Temperature, Precipitation and Heating and Cooling Degree Days, 1951-1980. Oregon. NOAA Environmental Data and Information Service, National Climatic Center, Asheville, NC)
Physical State	Score = 3	(Liquid substances were stored and spilled at the site, HMTC Phase 1 Records Search)
Containment	Score = 3	(Leaking Containers, no liner present, HMTC Phase 1 Records Search, SI Project Management Plan)
Waste Characteristics		
Toxicity/Persistence	Score = 15	(TCE, Toxicity Class 3 from Sax, Persistence Class 2 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Management Plan, with documented presence)

SITE 7 (cont'd)

Targets

Ground Water Use	Score = 2	(Portland Well Field, Municipal Supply with alternate supply available from Bull Run, Water Quality Report, Columbia Slough Water Quality Management Plan, City of Portland, September, 1988)
Distance to Wells/ Population Served	Score = 32	(Well records of USGS, Portland; City wells screened in deep aquifer; greater than 10,000 people served by well field)

Ground Water Route Scores

Route Score = 38.2

Surface Water Route

Release

Observed Release	Score = 0	(No release data, SI Project Management Plan)

Route Characteristics

Facility Slope	Score = 0	(Facility slope is 0.21%, derived from site topographic map, SI Project Management Plan Figure 2-3, no intervening terrain present between facility and target surface water body - Columbia Slough)
1 yr/24 hr Rainfall	Score = 3	(1 yr/24 hr rainfall data from HRS Manual Map, value = 3.5 inches)
Distance to Nearest Water/Pop. Served	Score = 3	(1000 feet to Columbia Slough along flow path of surface drainage)
Physical State	Score = 3	(Liquid substances stored and spilled on site, SI soil gas survey, HMTC Phase 1 Records Search)

SITE 7 (cont'd)

Containment	Score = 3	(Pit with no surface containment to prevent runoff, HMTC Phase 1 Records Search)
Waste Characteristics		
Toxicity/Persistence	Score = 15	(TCE, Toxicity Class 3 from Sax, Persistence Class 2 from HRS Manual)
Hazardous Waste Quantity	Score = 1	(Unknown waste quantity, SI Project Quantity Management Plan, with documented presence)
Targets		
Surface Water Use	Score = 2	(Columbia River used for recreation within 2 miles downstream of site, Columbia Slough Water Quality Management Plan, no drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base)
Distance to Sensitive Environment	Score = 1	(Fresh water wetland <1 mile west of the site, SI Project Management Plan)
Population Served/ Distance to Intake	Score = 0	(No drinking water sources on the Columbia River, Washington DSHS Water Supply Data Base, Columbia Slough Water Quality Management Plan)

<u>Surface Water Route Score</u> = 7.2

<u>Air Route</u>

No documented release to air has occurred from the sites, therefore a score of 0 is assigned to the Air Route (HRS Manual).

SITE 7 (cont'd)

MIGRATION SCORES FOR SITE 7

Ground Water Score (S_{gw}) = 38.2

Surface Water Score (S_{sw}) = 7.2

Air Score (S_a) = 0

Migration Score (S_M) = 22.5

APPENDIX I

ENVIRONMENTAL SENSITIVITY SCORES

TO ESTABLISH SOIL PHC CLEANUP LEVELS

APPENDIX I

ENVIRONMENTAL SENSITIVITY SCORES TO ESTABLISH PHC CLEANUP LEVELS – SITE 1

[Based on Oregon Cleanup Rules for Leaking Petroleum UST Systems]

Oregon's underground storage tank (UST) cleanup rules (OAR 340-122-325 through 340-122-335) include numeric soil cleanup levels for motor fuel and heating oil which are based on the environmental sensitivity of a given site. Environmental sensitivity scoring is used to establish a cleanup level. Five site-specific parameters are evaluated, scored, and summed in order to determine the appropriate cleanup level. The following information was used to determine the environmental sensitivity score and cleanup level requirement for Site 1 (Central Hazardous Waste Storage Area).

(1) Depth to Groundwater: <25 feet (SAIC field observations, 1988 & 1989).

SCORE: 10

(2) Mean Annual Precipitation: 37.39 inches (NOAA, 1982).

SCORE: 5

(3) Native Soil Type: Moderate permeability materials (SAIC field observations, 1988 &1989).

SCORE: 5

(4) Sensitivity of the Uppermost Aquifer: Potable aquifer not currently used for drinking water; quality assumed to be such that it could be used for drinking water. (SAIC field observations, 1988 & 1989).

SCORE: 4

(5) Potential Receptors:

(a) Distance to the nearest well: Medium ½ - 3 miles (USGS records).

(b) Number of people at risk: Many >3000 (conservative estimate).

SCORE: 10

(6) Matrix Score (sum of the above five parameter scores): 34

As stipulated in OAR 340-122-335, the Matrix score indicates the site must be cleaned up to at least the Level 2 standards listed in 340-122-335(2). The appropriate Level 2 target cleanup level for TPH is 500 ppm (non-gasoline) or 80 ppm (gasoline).

ENVIRONMENTAL SENSITIVITY SCORES TO ESTABLISH PHC CLEANUP LEVELS – SITE 2

[Based on Oregon Cleanup Rules for Leaking Petroleum UST Systems]

Oregon's underground storage tank (UST) cleanup rules (OAR 340-122-325 through 340-122-335) include numeric soil cleanup levels for motor fuel and heating oil which are based on the environmental sensitivity of a given site. Environmental sensitivity scoring is used to establish a cleanup level. Five site-specific parameters are evaluated, scored, and summed in order to determine the appropriate cleanup level. The following information was used to determine the environmental sensitivity score and cleanup level requirement for Site 2 (Civil Engineering Hazardous Material Storage Area).

(1) Depth to Groundwater: <25 feet (SAIC field observations, 1988 & 1989).

SCORE: 10

(2) Mean Annual Precipitation: 37.39 inches (NOAA, 1982).

SCORE: 5

(3) Native Soil Type: Moderate permeability materials (SAIC field observations, 1988 &1989).

SCORE: 5

(4) Sensitivity of the Uppermost Aquifer: Potable aquifer not currently used for drinking water; quality assumed to be such that it could be used for drinking water. (SAIC field observations, 1988 & 1989).

SCORE: 4

(5) Potential Receptors:

(a) Distance to the nearest well: Medium ½ - 3 miles (USGS records).

(b) Number of people at risk: Many >3000 (conservative estimate).

SCORE: 10

(6) Matrix Score (sum of the above five parameter scores): 34

As stipulated in OAR 340-122-335, the Matrix score indicates the site must be cleaned up to at least the Level 2 standards listed in 340-122-335(2). The appropriate Level 2 target cleanup level for TPH is 500 ppm (non-gasoline) or 80 ppm (gasoline).

APPENDIX I (cont'd)

ENVIRONMENTAL SENSITIVITY SCORES TO ESTABLISH PHC CLEANUP LEVELS - SITE 3

[Based on Oregon Cleanup Rules for Leaking Petroleum UST Systems]

Oregon's underground storage tank (UST) cleanup rules (OAR 340-122-325 through 340-122-335) include numeric soil cleanup levels for motor fuel and heating oil which are based on the environmental sensitivity of a given site. Environmental sensitivity scoring is used to establish a cleanup level. Five site-specific parameters are evaluated, scored, and summed in order to determine the appropriate cleanup level. The following information was used to determine the environmental sensitivity score and cleanup level requirement for Site 3 (Hush House Area).

(1) Depth to Ground Water: <25 feet (SAIC field observations, 1988 & 1989).

SCORE: 10

(2) Mean Annual Precipitation: 37.39 inches (NOAA, 1982).

SCORE: 5

(3) Native Soil Type: Moderate permeability materials (SAIC field observations, 1988 &1989).

SCORE: 5

(4) Sensitivity of the Uppermost Aquifer: Potable aquifer not currently used for drinking water; quality assumed to be such that it could be used for drinking water. (SAIC field observations, 1988 & 1989).

SCORE: 4

(5) Potential Receptors:

(a) Distance to the nearest well: Medium ½ - 3 miles (USGS records).

(b) Number of people at risk: Many >3000 (conservative estimate).

SCORE: 10

(6) Matrix Score (sum of the above five parameter scores): 34

As stipulated in OAR 340-122-335, the Matrix score indicates the site must be cleaned up to at least the Level 2 standards listed in 340-122-335(2). The appropriate Level 2 target cleanup level for TPH is 500 ppm (non-gasoline) or 80 ppm (gasoline).

APPENDIX I (cont'd)

ENVIRONMENTAL SENSITIVITY SCORES TO ESTABLISH PHC CLEANUP LEVELS – SITE 5B

[Based on Oregon Cleanup Rules for Leaking Petroleum UST Systems]

Oregon's underground storage tank (UST) cleanup rules (OAR 340-122-325 through 340-122-335) include numeric soil cleanup levels for motor fuel and heating oil which are based on the environmental sensitivity of a given site. Environmental sensitivity scoring is used to establish a cleanup level. Five site-specific parameters are evaluated, scored, and summed in order to determine the appropriate cleanup level. The following information was used to determine the environmental sensitivity score and cleanup level requirement for Site 5B (Former UST Area).

(1) Depth to Ground Water: <25 feet (SAIC field observations, 1988 & 1989).

SCORE: 10

(2) Mean Annual Precipitation: 37.39 inches (NOAA, 1982).

SCORE: 5

(3) Native Soil Type: Moderate permeability materials (SAIC field observations, 1988 &1989).

SCORE: 5

(4) Sensitivity of the Uppermost Aquifer: Unusable aquifer due to hydrologic condition of extremely low yield (SAIC field observations, 1988 & 1989).

SCORE: 1

(5) Potential Receptors:

(a) Distance to the nearest well: Medium ½ - 3 miles (USGS records).

(b) Number of people at risk: Many >3000 (conservative estimate).

SCORE: 10

(6) Matrix Score (sum of the above five parameter scores): 31

As stipulated in OAR 340-122-335, the Matrix score indicates the site must be cleaned up to at least the Level 2 standards listed in 340-122-335(2). The appropriate Level 2 target cleanup level for TPH (diesel) is 500 ppm.

APPENDIX I (cont'd)

ENVIRONMENTAL SENSITIVITY SCORES TO ESTABLISH PHC CLEANUP LEVELS - SITE 7

[Based on Oregon Cleanup Rules for Leaking Petroleum UST Systems]

Oregon's underground storage tank (UST) cleanup rules (OAR 340-122-325 through 340-122-335) include numeric soil cleanup levels for motor fuel and heating oil which are based on the environmental sensitivity of a given site. Environmental sensitivity scoring is used to establish a cleanup level. Five site-specific parameters are evaluated, scored, and summed in order to determine the appropriate cleanup level. The following information was used to determine the environmental sensitivity score and cleanup level requirement for Site 7 (Burn Pit Area).

(1) Depth to Groundwater: <25 feet (SAIC field observations, 1988 & 1989).

SCORE: 10

(2) Mean Annual Precipitation: 37.39 inches (NOAA, 1982).

SCORE: 5

(3) Native Soil Type: Moderate to high permeability materials (SAIC field observations, 1988 &1989).

SCORE: 10

(4) Sensitivity of the Uppermost Aquifer: Potable aquifer not currently used for drinking water; quality assumed to be such that it could be used for drinking water. (SAIC field observations, 1988 & 1989).

SCORE: 4

(5) Potential Receptors:

(a) Distance to the nearest well: Medium ½ - 3 miles (USGS records).

(b) Number of people at risk: Many >3000 (conservative estimate).

SCORE: 10

(6) Matrix Score (sum of the above five parameter scores): 39

As stipulated in OAR 340-122-335, the Matrix score indicates the site must be cleaned up to at least the Level 2 standards listed in 340-122-335(2). The appropriate Level 2 target cleanup level for TPH is 500 ppm (non-gasoline) or 80 ppm (gasoline).

APPENDIX J

LABORATORY DATA QA/QC VALIDATION REPORT

1.0 LABORATORY ANALYSIS - SOIL

The following is a summary of the data quality objectives (DQOs) for precision, accuracy, representativeness, comparability, and completeness (PARCC) obtained for soil samples (including sediments) analyzed during the Site Investigation (SI) conducted for the Oregon Air National Guard near Portland International Airport in Portland, Oregon (hereinafter referred to as ANG Portland, or "the Base").

- Precision - Precision was defined as the reproducibility, or degree of agreement, among replicate measurements of the same quantity. The closer the numerical values of the measurements come to each other, the more precise the measurement. Analytical precision was expressed as the percentage of the difference between results of duplicate samples for a given compound or element. Relative percent difference (RPD) was calculated as:

$$Precision = RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100\ percent$$

  where:

  C_1=Concentration of the compound or element in the sample

  C_2=Concentration of the compound or element in the duplicate/replicate

  Precision was determined using matrix spike/matrix spike duplicate analyses conducted on samples collected at ANG Portland. The laboratory selected one sample in 20 and split into three aliquots. The first aliquot was analyzed routinely for the parameters of interest, while the other two aliquots were spiked with known quantities of the parameters of interest prior to analysis. The RPD between the two spike results was calculated and used as an indication of the precision of the analyses performed.

  Based on the evaluation of the MS/MSD results presented in Sections 1.2 and 2.2, the overall laboratory precision is acceptable.

- Accuracy - Accuracy was defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement approaches the true value, or actual concentration, the more accurate the measurement. Analytical accuracy is expressed as the percent

recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. The following equation was used to calculate percent recovery:

$$Accuracy = Percent\ recovery = \frac{A_r - A_o}{A_f} \times 100\ percent$$

where:

A_r = Total compound or element concentration detected in the spiked sample

A_o = Concentration of the compound or element detected in the unspiked sample

A_f = Concentration of the compound or element added to the sample.

Laboratory accuracy also was assessed by evaluating method blank surrogate recovery, initial and continuing calibration, and MS/MSD results calculated from all analyses. Based on the evaluation of the laboratory QC blank, surrogate recovery, MS/MSD, and initial and continuing calibration results summarized in Sections 1.2 and 2.2, the overall laboratory accuracy is acceptable.

- Representativeness - Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Sample representativeness was ensured during the SI by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assessed by evaluating the RPD values calculated from the duplicate samples and by evaluating the concentrations of interferents detected in the field and laboratory QC blanks. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sampling techniques. Based on the evaluation of the factors described above summarized in Sections 1.2 and 2.2, the samples collected during the SI are considered to be representative of the environmental condition at ANG Portland.

- Comparability - Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. To optimize comparability, only the specific methods and protocols that were specified in the SI

Quality Assurance Project Plan (QAPP) were used to collect and analyze samples during the SI at ANG Portland. By using consistent sampling and analysis procedures, all data sets were comparable within a specified site at the Base, between sites at the Base, or among Air National Guard installations nationwide, to ensure that remedial action decisions and priorities were based on a consistent data base. Comparability also was ensured by the analysis of U.S. EPA reference materials establishing that the analytical procedures used were generating valid data. Based on the precision and accuracy assessment presented above, the data collected during the SI are generally considered to be comparable with that collected during previous investigations.

- Completeness - Completeness was defined as the percentage of valid data obtained from a measurement system. For data to be considered valid, it must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used. Based on the evaluation of the field and laboratory QC results presented in Sections 1.2 and 2.2, these data were considered greater than or equal to 98 percent, and as such, were used as the basis of all recommendations presented in this report.

1.1 SUMMARY OF PROCEDURES AND EQUIPMENT

The following sections review the procedures used to analyze soil boring samples collected during the Site Investigation (SI) conducted at ANG Portland.

1.1.1 Volatile Organic Compounds

All soil samples for which analyses of volatile organic compounds (VOCs) were requested were analyzed using U.S. EPA SW 846 Method 8240. A five-gram sample is purged directly in a specially-designed sparger and then analyzed using gas chromatography/mass spectrometry (GC/MS). Surrogate and internal standard compounds are added to the sample immediately prior to purging. Compounds are identified by comparing the ion chromatograms of the suspected analytes with the ion chromatograms of CLP target compounds contained in the mass spectrometer (MS) data system.

1.1.2 Semivolatile Organic Compounds

All soil samples for which analyses of semivolatile organic compounds (SVOCs) were requested were analyzed using U.S. EPA SW 846 Method 8270. This method involves gas chromatography/mass spectrometry using the capillary column technique. In this method, a 30-gram soil sample is extracted with methylene

chloride and acetone by sonication. Radio-labeled surrogate compounds are added to the sample before extraction. After the extraction is completed, the solvent is concentrated to a final volume of 1.0 mililiter (mL). Compounds used for quantitation of target compounds (i.e., internal standards) are added to the sample extract prior to instrumentational analysis. Target compounds are identified in the same manner as described above for VOCs.

1.1.3 Polychlorinated biphenyl Hydrocarbon Mixtures

All soil samples for which analyses of polychlorinated biphenyl hydrocarbon mixtures (PCBs) were requested were analyzed using U.S. EPA SW 846 Method 8080. Soil samples are prepared for this method in a manner similar to that used to extract soil samples for SVOCs, with the exception that dibutyl chlorendate is used as the surrogate. After extraction is complete, the methylene chloride/acetone solvent mixture is evaporated and then exchanged for hexane. The sample extract is analyzed using a gas chromatograph with an electron capture detector. Target compounds are identified by comparing the retention time of the suspected analyte with that of the target compound.

1.1.4 Petroleum Hydrocarbons

All soil samples were analyzed for petroleum hydrocarbons (PHCs) using a modified ASTM Method D3328. A major component of some PHC mixtures is the n-alkane or aliphatic hydrocarbon fraction. Therefore, evidence of contamination by PHCs such as kerosene, diesel fuel, and crude oil can be assessed by measuring the n-alkane fraction, C10-C20, in environmental samples. Soil samples (30 gm) were extracted three times with methanol/methylene chloride (35:65 v/v) using sonication procedures. A sulphuric cleanup was performed, the extract concentrated and solvent exchanged to hexane and silica gel. Fractionation was used to isolate the aliphatic hydrocarbons. Analyses were performed on the cleaned up extract. Prior to the analysis of samples and required blanks, the GC system was initially calibrated using a single point calibration of C-10 to C-20 aliphatic standard. Initial response factors for each aliphatic compound were used for final quantitation. A single point calibration was used because of the wide linearity of the FIC (flame ionization detector) into the high ppm range.

1.1.5 Trace Metals

All soil samples for which analyses of trace metals were requested were analyzed according to U.S. EPA SW-846, Third Edition methodologies. Cadmium (Method 7131) and lead (Method 7421) were analyzed using graphite furnace atomic absorption; the remainder of the metals were analyzed by inductively coupled argon plasma spectroscopy (ICAPS).

1.2 QUALITY ASSURANCE REVIEW AND RESULTS

Soils analysis data received from the SI was evaluated using Level C Quality Control (QC) as outlined in HAZWRAP's guidance: "Requirements For Quality Control of Analytical Data" (DOE, 1988), including recommended or required QC limits described in each applicable method as well as laboratory-calculated limits. This report discusses the following analytical criteria, where applicable: (1) surrogate recoveries (organic analyses only), (2) matrix spike/matrix spike duplicate (MS/MSD) analyses, (3) sample holding times, (4) calibration, (5) instrument tuning, (6) blanks, and (7) laboratory control samples. The results of the QC evaluation are discussed below by analysis type. Footnotes have been applied to the analytical data tabulated in Appendix A and in the body of the report (Section 6.0) based on the following conclusions.

1.2.1 Volatile Organic Compounds

Eighty-five field soil samples were analyzed for VOCs using U.S. EPA SW 846 Method 8240. Toluene-d_8 (81-117 percent), bromofluorobenzene (74-121 percent) and 1,2-dichloroethane-d_4 (70-121 percent) were used as surrogate compounds and were recovered in the following ranges: 82-117 percent, 74-117 percent, and 72-121 percent, respectively. All surrogate recoveries for these analyses were reported within the applicable limits.

1,1-Dichloroethene (59-172 percent), trichloroethene (62-137 percent), benzene (66-142 percent), toluene (59-139 percent) and chlorobenzene (60-133 percent) were used as MS/MSD spike compounds and were recovered in the following ranges: 55 to 131 percent, 66 to 135 percent, 66 to 92 percent, 64 to 96 percent, and 66 to 100 percent, respectively. Percent recoveries of spike compounds calculated from MS/MSD analyses and the RPDs of the duplicate spike analyses (1,1-dichloroethene [9-26 percent], trichloroethene [0-24 percent], benzene [1-24

percent], toluene [1-21 percent], and chlorobenzene [0-2 percent]) were within the laboratory-established control limits, except for the RPD for 1,1-dichloroethane and benzene in Sample S4-6 and the percent recovery for 1,1-dichloroethane in Sample D-3. Associated results have been footnoted.

HAZWRAP Level C requires a 14-day holding time for soil samples. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame. Methylene chloride was detected in method blank B19 at a concentration of 24 μg/L; associated results are flagged.

All GC/MS tuning criteria (i.e., those specified in the February 1988 USEPA Contract Laboratory Program [CLP] Statement of Work [SOW] for organics analyses), initial calibration criteria (i.e., system performance check compounds [SPCC] average relative response factors [RRFs] greater than or equal to 0.300, except for bromoform [greater than or equal to 0.250] and calibration check compound [CCC] percent relative standard deviation less than or equal to 30 percent), and continuing calibration criteria (i.e., SPCC RRFs greater than or equal to 0.25, except for bromoform [greater than or equal to 0.300] and CCC percent difference less than or equal to 25 percent) were met.

However, difficulty was encountered in meeting the GC/MS initial and continuing calibration required control limits for all Target Compound List (TCL) compounds. Using the CLP Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (U.S. EPA, 1988d) as a guidance document, much of the TCL results have been flagged as estimated values. Since positive results do not affect any decision documents, only the negative results are at issue and the question is whether the instrument was capable of detecting low levels of TCL analytes. Site 3 is the only critical site where data were used to support a decision document. All associated results where required control limits were exceeded have been flagged.

Review of the data suggests that the specific problems appeared to be a result of the instability of the mass spectrometer and not from the deterioration of the standards. This instability necessitated the laboratory to perform initial calibrations much more frequently than would normally be necessary. The

sensitivity of the mass spectrophotometer was sufficient and, if there were TCL compounds present in the samples, the identification would have been correct, however, the quantification would have been incorrect. Due to the fact that the data for Site 3 contained all non-detects, they should be accepted for the purposes of preparing a decision document for this site.

1.2.2 Semivolatile Organic Compounds

Sixteen field soil samples were analyzed for SVOCs using U.S. EPA SW 846 Method 8270. Nitrobenzene-d_5 (23-120 percent), 2-fluorobiphenyl (30-115 percent), phenol-d_5 (24-113 percent), 2-fluorophenol (25-121 percent), and 2,4,6-tribromophenol (19-122 percent) were used as surrogate compounds and were recovered in the following ranges: 29 to 91 percent, 30 to 80 percent, 24 to 109 percent, 30 to 90 percent, 28 to 91 percent, and 28 to 78 percent, respectively. All surrogate recoveries for these analyses were reported within the applicable limits.

Phenol (26-90 percent), 2-chlorophenol (25-102 percent), 1,4-dichlorobenzene (28-104 percent), n-nitroso-di-n-propylamine (41-126 percent), 1,2,4-trichlorobenzene (38-107 percent), 4-chloro-3-methylphenol (26-103 percent), acenaphthene (31-137 percent), 4-nitrophenol (11-114 percent), 2,4-dinitrophenol (28-89 percent), pentachlorophenol (17-109 percent), and pyrene (36-47 percent) were used as MS/MSD spike compounds and were recovered in the following ranges: 30 to 41 percent, 35 to 45 percent, 39 to 53 percent, 40 to 48 percent, 39 to 47 percent, 37 to 46 percent, 36 to 47 percent, 34 to 47 percent, 34 to 49 percent, 27 to 41 percent, and 36 to 47 percent, respectively. Percent recoveries of all spike compounds calculated from MS/MSD analyses and the RPDs of the duplicate spike analyses (phenol [31 percent], 2-chlorophenol [25 percent], 1,4-dichlorobenzene [30 percent], n-nitroso-di-n-propylamine [18 percent], 1,2,4-trichlorobenzene [19 percent], 4-chloro-3-methylphenol [22 percent], acenaphthene [27 percent], 4-nitrophenol [32 percent], 2,4-dinitrophenol [36 percent], pentachlorophenol [41 percent], and pyrene [27 percent]) were within the laboratory-established control limits.

HAZWRAP Level C requires a 14-day holding time for soil samples. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame.

Each GC/MS unit used was tuned and calibrated every 12-hour period. All GC/MS tuning criteria (i.e., those specified in the 2/88 CLP SOW), initial calibration criteria (i.e., all CCC percent RSDs were less than or equal to 30 percent and all SPCC RRF values were greater than or equal to 0.050), and continuing calibration criteria (i.e., all CCC percent differences were less than or equal to 25 percent and all SPCC RRF values were greater than or equal to 0.050) were met. No interferents were detected in blanks.

1.2.3 Polychlorinated Biphenyl Hydrocarbon Mixtures

Twenty-five field soil samples were analyzed for PCBs. Dibutyl chlorendate (24-150 percent) was used as a surrogate compound for these analyses and was recovered in a range from 0 to 263 percent. Surrogate recoveries for these analyses were reported within the applicable limits, except for a zero recovery of dibutylchorendate in Sample SB1-1-1. Since Aroclor 1254 was detected in Sample SB1-1-1, and is composed of a mixture of high molecular weight hydrocarbons, the concentration reported for this PCB is footnoted.

Percent recoveries of Arochlor 1254 (control limit = 46-133 percent) calculated from MS/MSD analyses (percent recovery range 0-57) and the RPDs of the duplicate spike analyses were within the laboratory-established control limits, except for results reported for Sample SB1-1-1. Recovery of Aroclor 1254 was 0 and 18 percent, less than the lower recovery limit of 46 percent established by the laboratory. Moreover, Aroclor 1254 was detected in this sample at a concentration of 350 μg/kg, which may account for the low recoveries of the spike PCB mixture. RPD values ranged from 0 to 200 percent. Associated results have been footnoted.

HAZWRAP Level C requires a 14-day holding time for soil samples before extraction and a 40-day holding time before analysis. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported

by the laboratory, all samples were analyzed within an acceptable time frame. Calibration verification was conducted daily and every 12-hour period thereafter. No interferents were detected in method blanks.

1.2.4 Petroleum Hydrocarbons

Sixty-one field soil samples were analyzed for PHCs using a modified ASTM Method D3328. Although not specified in the method, the surrogate compounds, hexamethylbenzene (HMB) and decylyclohexane (DCH) were added to some of the samples. Surrogate percent recovery limits were generated by the laboratory from in-house sample data. Sample surrogate values outside the control limits were due to interfering compound peaks that resulted in enhancing or masking recoveries. These samples generally contained significant amounts of C10-C20 petroleum hydrocarbons.

Recommended or required ranges of acceptable matrix spike recovery are not provided with this method, and laboratory-established control limits were not yet calculated for the December 1988 samples due to lack of data. Recommended or required corrective actions measures based on matrix or method spike recoveries also are not provided in this method. Zero percent recoveries were noted in Samples D4, SB1-1-1 and SB1-10-1, and are most likely due to matrix interference, since less than five times the concentration of petroleum hydrocarbons detected in the environmental samples was added to the MS/MSD samples. Also, a four percent spike recovery was encountered in method blank spike MB006 and is most likely due to the petroleum hydrocarbon interference detected in the associated method blank. Sample results associated with these QC check analyses have been footnoted.

No holding time limitations are required or recommended by this method; however, based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within 28 days, consistent with U.S. EPA Method 418.1 and HAZWRAP Level C guidance.

Calibration data applicable to petroleum hydrocarbon analyses performed on samples collected in December, 1988 indicate that only single-point calibrations were performed prior to analysis of these samples, instead of the

- Level C-required 3 to 5 point curve. All continuing calibration checks fell within the laboratory's criteria of +/- 20 percent. Forty field soil samples are affected; these include all 26 soil samples tested for petroleum hydrocarbons from Site 1, all 9 soil samples tested for petroleum hydrocarbons from Site 3, and five soil samples tested for petroleum hydrocarbons from the background location.

Petroleum hydrocarbons were detected in one of three method blanks at a concentration of 5.8 mg/kg; as noted above, associated results are flagged to identify this interference.

1.2.5 Trace Metals

Twenty-eight field soil samples were analyzed for one or more trace metals. Percent recoveries of all spike compounds calculated from MS/MSD analyses were within the method-recommended control limits (i.e., 75-125 percent). Control limits for the RPD of the duplicate spike analyses are not provided by SW-846, Third Edition; however, all values calculated from the duplicate spike recoveries were less than ten percent. Where limits are not provided, twenty percent typically is used as the upper limit of acceptable precision.

HAZWRAP Level C requires a six-month holding time for soil samples. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame.

All ICP and AA initial calibration and calibration verification criteria (i.e., percent recovery of 85-115) were met. Lead was detected in two of four method blanks at concentrations of 8.3 and 11 μg/L; associated results are flagged. No other interferents were detected in blanks.

2.0 LABORATORY ANALYSIS - WATER

The following is a summary of the data quality objectives (DQOs) for precision, accuracy, representativeness, comparability, and completeness (PARCC) obtained for water samples analyzed during the SI conducted at ANG Portland.

- Precision - Precision was defined as the reproducibility, or degree of agreement, among replicate measurements of the same quantity. The closer the numerical values of the measurements come to each other, the more precise the measurement. Analytical precision was expressed as the percentage of the difference between results of duplicate samples for a given compound or element. Relative percent difference (RPD) was calculated as:

$$Precision = RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100 \ percent$$

where:

C_1= Concentration of the compound or element in the sample

C_2= Concentration of the compound or element in the duplicate/replicate

Precision was determined using matrix spike/matrix spike duplicate analyses conducted on samples collected at ANG Portland. The laboratory selected one sample in 20 and split into three aliquots. The first aliquot was analyzed routinely for the parameters of interest, while the other two aliquots were spiked with known quantities of the parameters of interest prior to analysis. The RPD between the two spike results was calculated and used as an indication of the precision of the analyses performed.

Based on the evaluation of the MS/MSD results presented in Sections 1.2 and 2.2, the overall laboratory precision is acceptable.

- Accuracy - Accuracy was defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement approaches the true value, or actual concentration, the more accurate the measurement. Analytical accuracy is expressed as the percent recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. The following equation was used to calculate percent recovery:

$$Accuracy = Percent\ recovery = \frac{A_r - A_o}{A_f} \times 100\ percent$$

where:

A_r – Total compound or element concentration detected in the spiked sample

A_o – Concentration of the compound or element detected in the unspiked sample

A_f – Concentration of the compound or element added to the sample.

Laboratory accuracy also was assessed by evaluating method blank surrogate recovery, initial and continuing calibration, and MS/MSD results calculated from all analyses. Based on the evaluation of the laboratory QC blank, surrogate recovery, MS/MSD, and initial and continuing calibration results summarized in Sections 1.2 and 2.2, the overall laboratory accuracy is acceptable.

- Representativeness - Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Sample representativeness was ensured during the SI by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assessed by evaluating the RPD values calculated from the duplicate samples and by evaluating the concentrations of interferents detected in the field and laboratory QC blanks. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sampling techniques. Based on the evaluation of the factors described above summarized in Sections 1.2 and 2.2, the samples collected during the SI are considered to be representative of the environmental condition at ANG Portland.

- Comparability - Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. To optimize comparability, only the specific methods and protocols that were specified in the SI Quality Assurance Project Plan (QAPP) were used to collect and analyze samples during the SI at ANG Portland. By using consistent sampling and analysis procedures, all data sets were comparable within a specified site at the Base, between sites at the Base, or among Air National Guard installations nationwide,

to ensure that remedial action decisions and priorities were based on a consistent data base. Comparability also was ensured by the analysis of U.S. EPA reference materials establishing that the analytical procedures used were generating valid data. Based on the precision and accuracy assessment presented above, the data collected during the SI are generally considered to be comparable with that collected during previous investigations.

- Completeness - Completeness was defined as the percentage of valid data obtained from a measurement system. For data to be considered valid, it must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used. Based on the evaluation of the field and laboratory QC results presented in Sections 1.2 and 2.2, these data were considered greater than or equal to 98 percent, and as such, were used as the basis of all recommendations presented in this report.

2.1 SUMMARY OF PROCEDURES AND EQUIPMENT

The following sections review the procedures used to analyze water samples collected during the Site Investigation (SI) conducted at ANG Portland.

2.1.1 Volatile Organic Compounds

All water samples were analyzed for VOCs using U.S. EPA SW 846 Method 8240. A five-mL sample is purged directly in a specially-designed sparger and then analyzed using gas chromatography/mass spectrometry (GC/MS). Surrogate and internal standard compounds are added to the sample immediately prior to purging. Compounds are identified by comparing the ion chromatograms of the suspected analytes with the ion chromatograms of Method 8240 target compounds contained in the mass spectrometer (MS) data system.

2.1.2 Semivolatile Organic Compounds

All water samples were analyzed for SVOCs using U.S. EPA SW 846 Method 8270. This method involves gas chromatography/mass spectrometry using the capillary column technique. In this method, a 1.0 liter (L) groundwater or QC sample is prepared by liquid extraction using a methylene chloride/acetone mixture. Radio-labeled surrogate compounds are added to the sample before extraction. After the extraction is completed, the solvent is concentrated to a final volume

of 1.0 mL. Compounds used for quantitation of target compounds (i.e., internal standards) are added to the sample extract prior to instrumentational analysis. Target compounds are identified in the same manner as described above for VOCs.

2.1.3 Polychlorinated Biphenyl Hydrocarbon Mixtures

All water samples were analyzed for PCBs using U.S. EPA SW 846 Method 8080. Groundwater and QC samples are prepared for this method in a manner similar to that used to extract soil samples for SVOCs, with the exception that dibutyl chlorendate is used as the surrogate. After extraction is complete, the methylene chloride/acetone solvent mixture is evaporated and then exchanged for hexane. The sample extract is analyzed using a gas chromatograph with an electron capture detector. Target compounds are identified by comparing the retention time of the suspected analyte with that of the target compound.

2.1.4 Petroleum Hydrocarbons

All water samples were analyzed for PHCs using a modified ASTM Method D3328. A major component of some PHC mixtures is the n-alkane or aliphatic hydrocarbon fraction. Therefore, evidence of contamination by PHCs such as kerosene, diesel fuel, and crude oil can be assessed by measuring the n-alkane fraction, C10-C20 in environmental samples. Water samples (one liter) were extracted three times with methanol/methylene chloride (35:65 v/v) in a separatory funnel, the extract concentrated and solvent exchanged to hexane. A sulphuric cleanup was performed. Fractionation was used to isolate the aliphatic hydrocarbons. Analyses were performed on the cleaned up extract. Prior to the analysis of samples and required blanks, the GC system was initially calibrated using a single point calibration of C-10 to C-20 aliphatic standard. Initial response factors for each aliphatic compound was used for final quantitation. A single point calibration was used because of the wide linearity of the FIC (flame ionization detector) into the high ppm range.

2.1.5 Trace Metals

All water samples for which analyses of trace metals were requested were analyzed according to U.S. EPA SW-846, Third Edition methodologies. Cadmium (Method 7131)

and lead (Method 7421) were analyzed using graphite furnace atomic absorption; the remainder of the metals were analyzed by inductively coupled argon plasma spectroscopy (ICAPS).

2.1.6 Sulfate

Half of the water samples for which analyses of sulfate were requested were analyzed according to U.S. EPA SW 846 Method 9038; the remaining samples were analyzed according to U.S. EPA SW 846 Method 300. In Method 9038, sulfate ion is converted to a barium sulfate suspension under controlled conditions. The resulting turbidity is determined by a spectrophotometer and compared with a curve prepared from standard sulfate solution. Method 300 utilizes ion chromatography to isolate and quantify sulfate ions.

2.2 QUALITY ASSURANCE REVIEW AND RESULTS

2.2.1 Volatile Organic Compounds

Fifty-one field water samples were analyzed for VOCs by U.S. EPA SW 846 Method 8240. Three surrogate compounds (i.e., 1,2-dichloroethane-d_4 [76-114 percent], toluene-d_8 [88-110 percent], and 4-bromofluorobenzene [86-115 percent]) were added to each sample before each analysis to monitor the purging efficiency of the liquid sample concentrater. The surrogates were recovered in the following ranges: 0 to 114 percent, 88 to 110 percent, and 87 to 113 percent, respectively. In four samples (MW1-1, MW1E-1, R-2, and RE-2) poor recovery of 1,2-dichloroethane-d_4 was determined to be the result of matrix interference from bromochloromethane found in the environmental samples. Bromochloro-methane, an internal standard, is added to each sample before purging and analysis, and is used to quantify surrogate recovery and the concentration of detected compounds in the applicable retention time range. Therefore, if this compound is also present in the sample in significant concentrations, as was reported, then quantification of the compounds in close retention time proximity to bromochloromethane will be affected. Volatile organic compound data reported from the analysis of samples MW1-1, MW1E-1, R-2, and RE-2 have been footnoted to note this matrix interference.

1,1-Dichloroethene (61-145 percent), trichloroethene (71-120 percent), benzene (76-127 percent), toluene (76-125 percent), and chlorobenzene (75-130 percent)

were used as spike compounds for this analysis and were recovered in the following ranges: 74 to 90 percent, 116 to 122 percent, 117 to 120 percent, 50 to 53 percent, and 99 to 103 percent, respectively. Percent recoveries of all spike compounds calculated from MS/MSD analyses and the RPD values of the duplicate spike analyses (1,1-dichloroethene [20 percent], trichloroethene [5 percent], benzene [3 percent], toluene [5 percent], and chlorobenzene [4 percent]) were within the laboratory-established control limits.

HAZWRAP Level C requires a 7-day holding time for water samples, unless they are preserved to pH < 2 with HCl (then the holding time is 14 days). Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, not all samples were analyzed within an acceptable time frame. Exceeding the holding time does not impair the usefulness of data for purposes of the SI except in cases where no VOAs were detected at a given Site and this information is used to prepare a decision document that no further investigation is required. The only Site in this category is Site 3, and all Site 3 samples met the 7-day holding time. Hence, the fact that the samples were not preserved with acid has not compromised the usefulness of any of the data for purposes of the SI. However, all associated data with holding time violations has been flagged.

The GC/MS tuning, initial calibration, and continuing calibration criteria (i.e., the 2/88 CLP SOW criteria previously described) encountered the same difficulty previously discussed in Section 1.2.1. Methylene chloride was detected in one of thirteen method blanks at a concentration 17 $\mu g/L$; associated samples are flagged. No other interferents were detected in blanks.

2.2.2 Semivolatile Organic Compounds

Eighteen field water samples were analyzed for SVOCs. Nitrobenzene-d_5 (35-114 percent), 2-fluorobiphenyl (43-116 percent), terphenyl (33-141 percent), phenol-d_5 (10-94 percent), 2-fluorophenol (21-100 percent), and 2,4,6-tribromophenol (10-123 percent) were used as surrogate compounds for this analysis, and were recovered in the following ranges: 60 to 80 percent, 60 to 69 percent, 65 to 80 percent, 0 to 45 percent, 2 to 53 percent, and 28 to 109 percent, respectively.

- Lower than method-recommended recoveries for two surrogates in MW1-1 (phenol-d_5 and 2-fluorophenol) were reported; associated results have been footnoted to indicate surrogate recoveries were outside QC limits. In addition, in four other samples, surrogate recoveries exceeded QC limits due to matrix interfeıence (Samples D-7, MW7-1-1, MW7-2-1, and MW7-3-1); all associated results have been footnoted. Surrogate recoveries for the remaining analyses were reported within the applicable limits.

Phenol (12-89 percent), 2-chlorophenol (27-123 percent), 1,4-dichlorobenzene (36-97 percent), n-nitroso-di-n-propylamine (41-116 percent), 1,2,4-trichlorobenzene (39-98 percent), 4-chloro-3-methylphenol (23-97 percent), acenaphthene (46-118 percent), 4-nitrobenzene (10-80 percent), 2,4-dinitrotoluene (24-96 percent), pentachlorophenol (9-103 percent), and pyrene (26-127 percent) were used as MS/MSD spike compounds, and were recovered in the following ranges: 55 to 59 percent, 141 to 159 percent, 59 to 66 percent, 77 to 81 percent, 67 to 76 percent, 26 to 42 percent, 67 to 71 percent, 0 to 23 percent, 69 to 76 percent, 62 percent, and 72 to 78 percent, respectively.
Almost all the percent recoveries of spike compounds calculated from MS/MSD analyses and the RPDs of the duplicate spike analyses (phenol [7 percent], 2-chlorophenol [12 percent], 1,4-dichlorobenzene [11 percent], n-nitroso-di-n-propylamine [5 percent], 1,2,4-trichlorobenzene [13 percent], 4-chloro-3-methylphenol [7 percent], acenaphthene [6 percent], 4-nitrobenzene [0 percent], 2,4-dinitrotoluene [10 percent], pentachlorophenol [0 percent], and pyrene [8 percent]) were within the laboratory-established control limits. Exceptions were 4-nitrophenol (zero percent versus a method-recommended lower limit of 11 percent) and 2-chlorophenol (141 to 252 percent versus a method-recommended upper limit of 102 percent) on one MS/MSD (sample R2). Since percent recoveries of these compounds were similar in both the blank spike and MS/MSD and the recovery of 2-chlorophenol was approximately twice that expected, it appears the spiking solution was improperly prepared (i.e., 2-chlorophenol was added twice to the solution and 4-nitrophenol was omitted).

HAZWRAP Level C requires a 7-day holding time for water samples to be extracted and 40-day holding time before analysis. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame.

All GC/MS tuning, initial calibration, and continuing calibration criteria were met (i.e., 2/88 CLP SOW criteria previously described). The compound bis-(2-ethylhexyl)phthalate was detected in one of four method blanks at a concentration of 52 μg/L; associated results are flagged. No other interferents were detected in blanks.

2.2.3 Polychlorinated Biphenyl Hydrocarbon Mixtures

Twelve field water samples were analyzed for PCBs. Recoveries of the surrogate compound dibutylchlorendate (DBC) were zero percent for four samples and two laboratory blanks (FB-4, MW1-1, R-2, EW-4, MB007, and MBMS 007). The accompanying laboratory narrative suggested that DBC was apparently not added to these samples and blanks before extraction; associated results have been footnoted. All other surrogate recoveries for these analyses were reported within the applicable limits.

Percent recoveries (i.e., 80 to 82 percent) of all spike compounds calculated from MS/MSD analyses and the RPDs of the duplicate spike analyses (i.e., zero percent, advisory limit = 50 percent) were within the laboratory-established control limits (i.e., 56 to 123 percent). HAZWRAP Level C requires a 7-day holding time for extraction of water samples. All extracts should be analyzed within 40 days. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame.

Arochlor 1254 was detected in one of three method blanks (MB007) at a concentration of 0.8 μg/L; associated results have been footnoted. Calibration verification was conducted daily and every 12-hour period thereafter.

2.2.4 Petroleum Hydrocarbons

Twenty-one field water samples were analyzed for PHCs. Although not specified in the method, the surrogate compounds, hexamethylbenzene (HMB) and decylyclo-hexane (DCH) were added to some of the samples. Surrogate percent recovery limits were generated by the laboratory from in-house sample data. Surrogate recovery values were within the control limits for all samples.

- Recommended or required ranges of acceptable MS/MSD recovery are not provided with this method, and laboratory-established control limits were not yet calculated for the December 1988 samples due to lack of data. Recommended or required corrective actions measures based on matrix or method spike recoveries also are not provided in this method. Control limits were not met for samples D8 and EW7; associated sample results have been footnoted.

No holding time limitations are required or recommended by this method; however, based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within 28 days, consistent with U.S. EPA Method 418.1 and HAZWRAP Level C guidance. No interferents were detected in blanks.

Calibration data applicable to petroleum hydrocarbon analyses performed on samples collected in December, 1988 indicate that only single-point calibrations were performed prior to analysis of these samples, instead of the Level C-required 3 to 5 point curve. All continuing calibration checks fell within the laboratory's criteria of +/- 20 percent. Ten field aqueous samples are affected; these include one from Site 2 (MW2-1), two Site 3 (MW3-1, and R3), one from Site 5 (MW5-2), and several field QC blanks (EW1-1, EW3-1, F1-1, EW-4, FB3-1, and FB4).

2.2.5 Trace Metals

Twenty-one field water samples were analyzed for one or more trace metals. Cadmium (95 to 114 percent), total chromium (97 to 101 percent), iron (86 to 106 percent), lead (100 to 110 percent), nickel (90 to 100 percent), and zinc (94 to 110 percent) were used as spike elements for this analysis. All percent recoveries of all spike compounds calculated from MS/MSD analyses were within the method-recommended control limits (i.e., 75 to 125 percent). Control limits for the RPD of the duplicate spike analyses are not provided by SW-846, Third Edition; however, all values calculated from the duplicate spike recoveries are less than ten percent. Where limits are not provided, twenty percent typically is used as the upper limit of acceptable precision.

- HAZWRAP Level C requires a six-month holding time for soil samples. Based on the sample collection dates reported on the chain-of-custody documentation and the analysis dates reported by the laboratory, all samples were analyzed within an acceptable time frame.

All ICP and AA initial calibration and calibration verification criteria (i.e., 85 to 115 percent recovery) were met. No interferents were detected in laboratory blanks.

2.2.6 Sulfate

Nine field water samples were analyzed for sulfate. There are no established QC limits for this procedure.

APPENDIX K

FIELD CHANGE FORMS

SAIC.

FIELD CHANGE REQUEST

Project Number: 1-817-03-471-02

Field Change No. 1 Page 1 of 1

Project Number: 1-817-03-471-02 (HAZWRAP PROGRAM)

Project Name: SITE INVESTIGATION, AIR NATIONAL GUARD, PORTLAND, OREGON

CHANGE REQUEST

Applicable Reference: Project Management Plan and Sampling & Analysis Plan.

Description of Change: Work plans call for water samples to be filtered prior to analysis for metals. Instead, samples will not be filtered prior to analysis for metals.

Reason for Change: Difficult to avoid cross contamination when filtering in the field. Difficult to comply with holding times (EPA SW846) if filtering at the lab. EPA Region 10 recommended not filtering for Whidby HAZWRAP Project.

Impact on Present and Completed Work: No change to schedule or budget.

Requested by: DARYL D. JECH Date: 08 / 09 / 89
(SAIC ~~Field Geologist~~/Engineer)

Acknowledged by: Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition: N/A

Recommendation by: N/A Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition: Obtained verbal agreement from HAZWRAP (Gail McKeon) on August 9. Obtained verbal confirmation from Carl Wheeler on August 16.

Approved/Disapproved by: Daryl D. Jech Date: 08 / 16 / 89
(SAIC Project Manager)

SAIC

FIELD CHANGE REQUEST

Project Number: 1-817-03-471-02

Field Change No. 2 Page 1 of 1

Project Number: 1-817-03-471-02

Project Name: SITE INVESTIGATION, ANG PORTLAND, OREGON.

CHANGE REQUEST

Applicable Reference: FIELD SAMPLING PLAN /SOPs'

Description of Change:

USE CENTRIFUGAL PUMP WITH DEDICATED SUCTION HOSE (FOR EACH WELL) RATHER THAN SUBMERSIBLE PUMP FOR WELL DEVELOPMENT & SLUG TESTING.

Reason for Change: LESS CHANCE OF CROSS-CONTAMINATION, REDUCED DECON EFFORT, EASIER TO USE.

Impact on Present and Completed Work: NO DELAY IN SCHEDULE OR SIGNIFICANT INCREASE IN COST IS EXPECTED. MAY SAVE TIME & COULD SAVE $ FOR DECON EQUIPMENT &/OR ANALYSES.

Requested by: Brett [signature] Date: 8 / 8 / 89
(SAIC Field Geologist/Engineer)

Acknowledged by: N/A Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition: N/A

Recommendation by: Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition: Approved change.

Approved/Disapproved by: [signature] Date: 25 AUG 89
(SAIC Project Manager)

SAIC	FIELD CHANGE	Project Number: 1-817-03-471-02

Field Change No. 3 Page 1 of ____

Project Number: 1-817-03-471-02

Project Name: SITE INVESTIGATION, ANG PORTLAND, OREGON

CHANGE

Applicable Reference: FIELD SAMPLING PLAN, SOP'S

Description of Change: USE TERRA DATA LOGGER INSTEAD OF HERMIT DATA LOGGER FOR SLUG TESTS.

Reason for Change: MORE COST-EFFECTIVE. LOCAL SUPPORT (FROM BELLEVUE, WASHINGTON COMPANY). SUGGESTED BY MARK DAGLE PRIOR TO FIELD WORK BASED ON EXPERIENCE AT WHIDBEY HAZWRAP PROJECT

Impact on Present and Completed Work: NONE

Requested by: N/A (SAIC Field Geologist/Engineer) Date: / /

Acknowledged by: N/A (Subcontractor Representative/Company Name) Date: / /

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition: N/A

Recommendation by: N/A (SAIC Field Operations Manager) Date: / /

PROJECT MANAGER APPROVAL

Final Disposition: The change was implemented by the field operations manager.

Approved/Disapproved by: [signature] (SAIC Project Manager) Date: 25 / AUG / 89

SAIC	FIELD CHANGE	Project Number: 1-817-03-471-02

Field Change No. 4 Page 1 of 1

Project Number: as above

Project Name: SITE INVESTIGATION, ANG PORTLAND, OR.

CHANGE

Applicable Reference: FIELD SAMPLING PLAN / PROJECT MANAGEMENT PLAN

Description of Change: MW2-2 was field-located south of MW2-1 rather than north of MW2-1 as shown in the work plans.

Reason for Change: Soil gas survey indicated highest volatile contamination was to the south rather than to north. Proposed relocation of MW2-2 was sent by FAX to MMES Project Manager who did not object.

Impact on Present and Completed Work: None. Intent of soil gas survey was to aid in locating monitoring wells in the most logical places; the intent is followed by this field change.

Requested by: N/A Date: / /
(SAIC Field Geologist/Engineer)

Acknowledged by: N/A Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition: N/A

Recommendation by: N/A Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition: The change was initiated by the SAIC project manager and carried out by the field operations manager.

Approved/Disapproved by: [signature] Date: 25 / AUG / 89
(SAIC Project Manager)

SAIC.

FIELD CHANGE

Project Number: 1-817-03-471-02

Field Change No. 5 Page 1 of 1

Project Number: as above

Project Name: SITE INVESTIGATION, ANG PORTLAND

CHANGE

Applicable Reference: PROJECT MANAGEMENT PLAN

Description of Change: Monitoring wells were field located in slightly different locations ~~that~~ than indicated in the work plans for Site 7 - Burn Pit.

Reason for Change: Two wells were moved to ANG side of property line (rather than Port of Portland side), in order to keep wells off Port property and locate on edge of apparent plume based on soil gas survey. Locations matched ANG Bureau input to the extent feasible. Locations also chosen to avoid ANG construction west of Site 7.

Impact on Present and Completed Work: No impact to schedule or quantity.

Requested by: N/A (SAIC Field Geologist/Engineer) Date: / /

Acknowledged by: N/A (Subcontractor Representative/Company Name) Date: / /

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition: N/A

Recommendation by: N/A (SAIC Field Operations Manager) Date: / /

PROJECT MANAGER APPROVAL

Final Disposition: Changes were coordinated with MMES & NGB by SAIC project manager and carried out by the field operations manager.

Approved/Disapproved by: [signature] (SAIC Project Manager) Date: 25 / Aug / 89

SAIC

FIELD CHANGE REQUEST

Project Number: 1 817 03 471 02

Field Change No. 6 Page 1 of 1

Project Number: See above

Project Name: PORTLAND ANG

CHANGE REQUEST

Applicable Reference: See attached map

Description of Change: Need to move the location of several sediment sampling locations

Reason for Change: A portion of the drainage ditch has been filled in (sample #4). After a field reconaissance with PM Daryl, some sample locations were moved to be closer to storm sewer and other drainage outfalls.

Impact on Present and Completed Work: None expected.

Requested by: Brett R. [signature] (FOM) Date: 8 / 15 / 89
(SAIC Field Geologist/Engineer)

Acknowledged by: Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

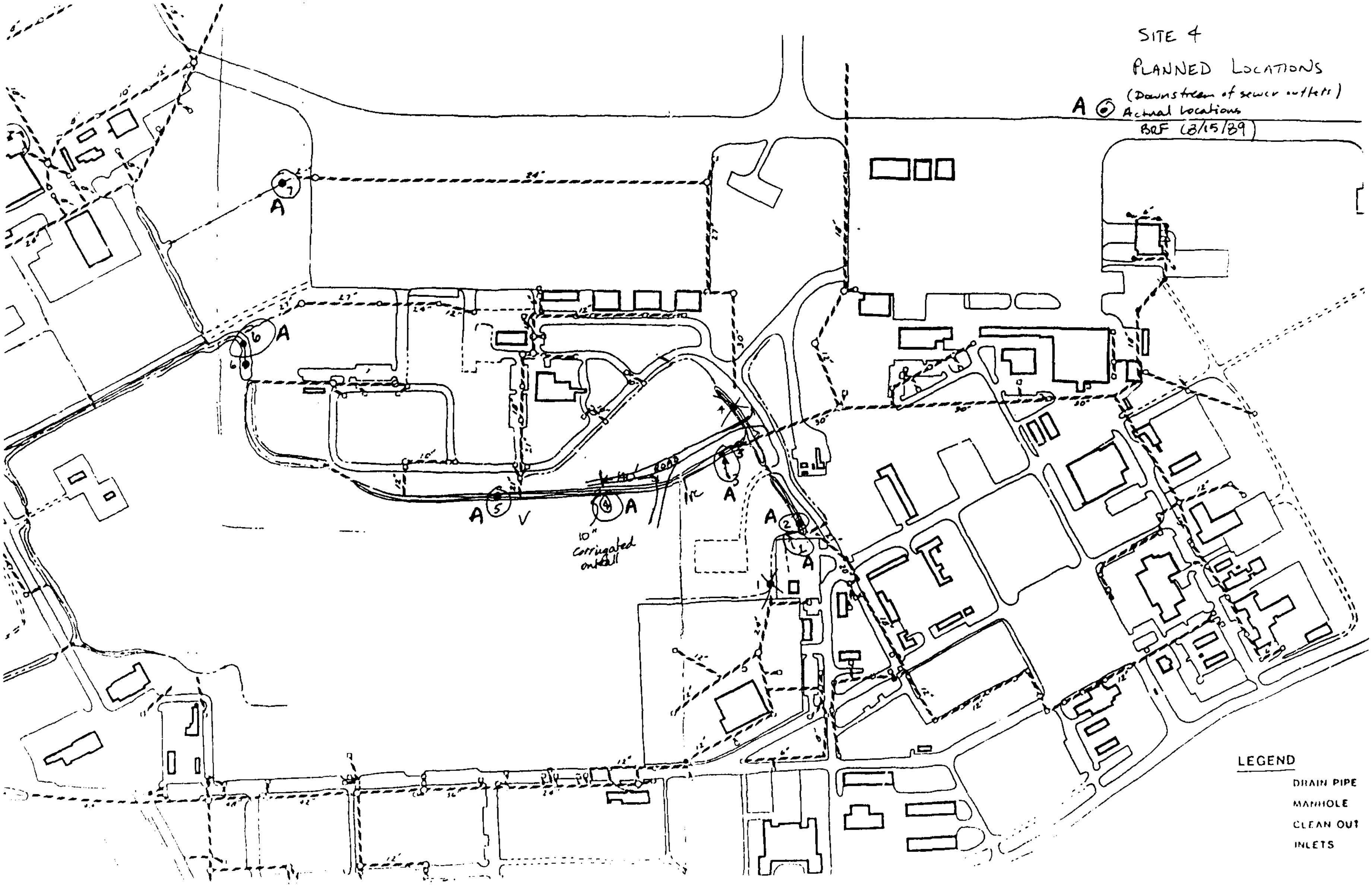
Recommended Disposition:

Recommendation by: Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition: Changed locations are shown on attached figure.

Approved/Disapproved by: [signature] Date: 8 / 15 / 89
(SAIC Project Manager)


SITE 4
PLANNED LOCATIONS
(Downstream of sewer outlets)
A ⑤ Actual Locations
BRF 6/15/89
10" corrigated outfall
LEGEND
DRAIN PIPE
MANHOLE
CLEAN OUT
INLETS

SAIC	FIELD CHANGE REQUEST	Project Number: 1 817 03 471 02

Field Change No. ~~02~~ 7 4 Page 1 of 2

Project Number: See above

Project Name: OREGON AIR NATIONAL GUARD at Portland, OR

CHANGE REQUEST

Applicable Reference: Field Sampling Plan & Project Work Plan

Description of Change: Need to move a few soil sample locations at SITE 5 to avoid interfering with construction activities and to collect a sample from an obvious oil-stain (see attached sheet).

Reason for Change: See above

Impact on Present and Completed Work: None

Requested by: Brett R. Freier (FOM) Date: 8/16/89
(SAIC Field Geologist/Engineer)

Acknowledged by: ______ Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

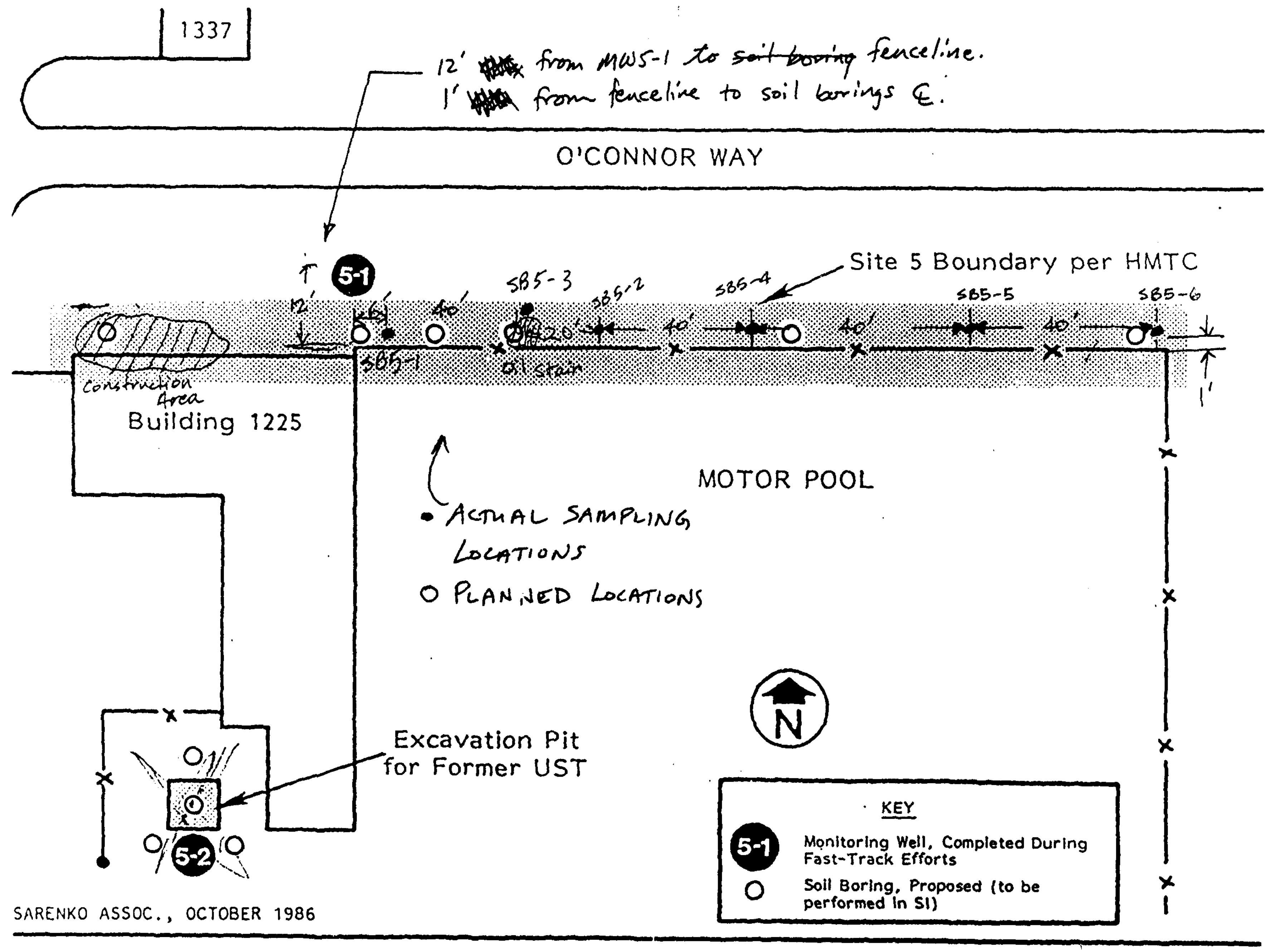
Recommended Disposition:

Recommendation by: ______ Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition:

Approved/Disapproved by: [signature] Date: 8/16/89
(SAIC Project Manager)



SARENKO ASSOC., OCTOBER 1986

SAIC

FIELD CHANGE REQUEST

Project Number: 1 817 03 471 02

Field Change No. 8 dj   Page 1 of 1

Project Number: SEE ABOVE

Project Name: OREGON ANG PORTLAND

CHANGE REQUEST

Applicable Reference: Field Sampling Plan – SOP 350

Description of Change: SOP states that grout mixture will be verified using a mud balance. We will instead verify by recording the grout composition (ratio of bentonite to cement to water).

Reason for Change: We do not have a mud balance (And the above procedure will be adequate for accomplishing the same objective – dj)

Impact on Present and Completed Work: None expected

Requested by: Brett R. [signature] (FOM)   Date: / /
(SAIC Field Geologist/Engineer)

Acknowledged by: ____   Date: / /
(Subcontractor Representative/Company Name)

FIELD OPERATIONS MANAGER RECOMMENDATION

Recommended Disposition:

Recommendation by: ____   Date: / /
(SAIC Field Operations Manager)

PROJECT MANAGER APPROVAL

Final Disposition:

Approved/Disapproved by: [signature]   Date: 8 / 25 / 89
(SAIC Project Manager)

APPENDIX L

CHAIN OF CUSTODY FORMS

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 1

Project: PORTLAND AIR NATIONAL GUARD 1-817-03-471

Reason for Transfer: ANALYSES

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	12/8/88	1424	SITE 1	SB1-11-1	S	Soil	2	VOC SW5030/8240
2	12/8/88	1441	"	SB1-11-2	S	Soil	2	" " "
3	"	1350	"	SB1-12-1	S	"	2	" " "
4	"	1405	"	SB1-12-2	S	"	2	" " "
5	"	1550	"	SB1-2-1	S	"	2	" " "
6	"	1555	"	SB1-2-1D	R	"	2	" " "
7	"	1600	"	SB1-2-2	S	"	2	" " "
8	"	1511	"	SB1-1-1	S	"	2	" " "
9	"	1517	"	SB1-1-2	S	"	2	" " "
10	"	1424	"	SB1-11-1	S	"	1	PCB's, PHC, % moisture
11	"	1441	"	SB1-11-2	S	"	1	~~PCB's~~ DP 12-12-88, PHC, % Moisture
12	"	1350	"	SB1-12-1	S	"	1	" " "
13	"	1405	"	SB1-12-2	S	"	1	~~"~~ DP 12-12-88 " "
14	"	1550	"	SB1-2-1	S	"	1	" " "
15	"	1555	"	SB1-2-1D	R	"	1	" " "
16	"	1600	"	SB1-2-2	S	"	1	~~"~~ DP 12-12-88 " "
17	"	1511	"	SB1-1-1	S	"	1	" " "
18	"	1517	"	SB1-1-2	S	"	1	~~"~~ DP 12-12-88 " "
19	~~12/8/88~~		"	TB-1	B	Water	2	VOA/VOH SW 5030/8240
20	/							
Column Total:							28	

Signature & Affiliation PLEASE

Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
[signature] / SAIC - Seattle			
Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
Relinquished by / Affiliation:	Received by / Affiliation: [signature] SAIC	Date/Time: 12-10-88 0905	Condition: OK

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882329 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 1

Project: PORTLAN ANG .

Reason for Transfer: ANALYSIS

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	12/9/88	0949	SITE 1	SB1-4-2	S	Soil	2	VOCs (SW) 5030/8240
2	12/9/88	1148	" "	SB1-9-2R	R	Soil	2	" "
3		1300		SB1-5-2	S	"	"	" "
4		1040		SB1-8-2	S	"	"	" "
5		1030		SB1-8-1	S	"	"	" "
6		1138		SB1-9-1	S	"	"	" "
7		1340		SB1-10-2	S	"	"	" "
8		1148		SB1-9-2	S	"	"	" "
9		0850		SB1-3-1	S	"	"	" "
10		~~0850~~ 0900		SB1-3-2	S	"	"	" "
11		0820		EW1-1	SB	Water	2	" "
12		1340		SB1-10-2	S	Soil	1	PHC, %M
13		0820		EW1-1	(B)	Water	1	PCB
14		1325		SB1-10-1	S	Soil	1	PHC, ~~PCB~~, %M 12/12/88
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Brett R. Fruin / SAIC		1425/12/9/88	Good
Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Relinquished by/Affiliation:	Received by/Affiliation: D Patel SAIC	Date/Time: 12-10-88 0905AM	Condition: OK

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Page 1 of 1

SRG # 882328

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 2

Project: PORTLAND AIR NATIONAL GUARD 1-817-03-471

Reason for Transfer: ANALYSES

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	~~12-9-88~~	~~0800~~	~~SITE #1~~					
2	12-9-88	0815	SITE # 1	FB1-1	B	WATER	2	VOA/VOH (SW5030/8240)
3	12-9-88	0815	"	F1-1	B	"	1	PHC's (ASTM C_8-C_{20})
4	"	"	"	F1-1	B	"	1	PCB's (SW3550/8080)
5	12-9-88	0820	"	EW1-1	B	"	1	PHC's (ASTM C_8-C_{20})
6	"	1055	"	SB1-7-1	S	SOIL	1	PHC, PCB, %m
7	"	1110	"	SB1-7-2	S	"	1	PHC, %m
8	"	1030	"	SB1-8-1	S	"	1	PHC, PCB, %m
9				~~FB-2~~	~~B~~	~~WATER~~	~~2~~	~~VOA/VOH (SW5030/8240)~~
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:							8	

"F1-1" is FB1-1.

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Daryl Dyck / SAIC			
	D Pat / SAIC	12-10-88 / 0905 AM	OK

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG # 882330 Page ____ of ____

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

00632

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 2

Project: PORTLAND AIR NATIONAL GUARD 1-817-03-471

Reason for Transfer: ANALYSES

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	~~12-9-88~~	~~0800~~	~~SITE #1~~					
2	12-9-88	0815	SITE #1	FB1-1	B	WATER	2	VOA/VOH (SW5030/8240)
3	12-9-88	0815	"	F1-1	B	"	1	PHC's (ASTM C8-C20)
4	"	"	"	F1-1	B	"	1	PCB's (SW3550/8080)
5	12-9-88	0820	"	EW1-1	B	"	1	PHC's (ASTM C8-C20)
6	"	1055	"	SB1-7-1	S	SOIL	1	PHC, PCB, %m
7	"	1110	"	SB1-7-2	S	"	1	PHC, %m
8	"	1030	"	SB1-8-1	S	"	1	PHC, PCB, %m
9				~~FB-2~~	~~B~~	~~WATER~~	~~2~~	~~VOA/VOH (SW5030/8240)~~
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:							8	

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Daryl Dyck / SAIC			
	D Pat / SAIC	12-10-88 / 0905AM	OK

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG # 882330 Page ______ of ______

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

00635

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 3

Project: PORTLAND AIR NAT'L GUARD 1-817-03-471

Reason for Transfer: ANALYSES

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	12/9/88	1140	SITE #1	SB1-9-1	S	SOIL	1	PHC, PCB, % M
2	12/988	0942	"	SB1-4-1	S	"	1	" " "
3	"	1215	"	SB1-6-1	S	"	1	" " "
4	"	1250	"	SB1-5-1	S	"	1	" " "
5	"	1225	"	SB1-6-2	S	"	1	" " "
6	"	1150	"	SB1-9-2	S	"	1	" " "
7	"	1150	"	SB1-9-2R	R	"	1	" " "
8	"	0949	"	SB1-4-2	S	"	1	PHC, % M
9	"	1300	"	SB1-5-2	S	"	1	" "
10	"	1040	"	SB1-8-2	S	"	1	" "
11				TB-2	B	WATER	2	Trip Blank #2 VOA VOH
12	12/9/88	0850	"	SB1-3-1	S	SOIL	1	PHC, PCB, % M
13	"	0900	"	SB1-3-2	S	"	1	PHC, % M
14	"	1325	"	SB1-10-1	S	"	2	VOA/VOH (SW5030/8240)
15	"	1055	"	SB1-7-1	S	"	2	" " " "
16	"	1225	"	SB1-6-2	S	"	2	" " " "
17	"	1110	"	SB1-7-2	S	"	2	" " " "
18	"	1215	"	SB1-6-1	S	"	2	" " " "
19	"	1250	"	SB1-5-1	S	"	2	" " " "
20	"	0942	"	SB1-4-1	S	"	2	" " " "
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
[signature]		12/9/88 1445	Good
	D. [signature] / SAIC	12-10-88/ 0905AM	OK

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882331

Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

00634

SAIC Science Applications International Corporation	SAMPLE CHAIN OF CUSTODY LOG	Shipment No. 2

Project: PORTLAND ANG

Reason for Transfer: ANALYSIS

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	12/13/88	1130	SITE 2	SB2-4-1	S	Soil	2	SW5030/8240
2	12/13/88	1140	" "	SB2-4-2	S	"	"	" "
3	12/13/88	~~1140~~ 1130	" "	SB2-4-1R	~~S~~R	"	"	" "
4	12/13/88	0935	" "	SB2-1-1	S	"	"	" "
5	12/13/88	1025	"	SB2-2-2	S	"	"	" "
6	" "	1015	" "	SB2-2-1	S	"	"	"
7	" "	0850	" "	SB2-3-2	S	"	"	" "
8	"	0845	" "	SB2-3-1	S	"	"	" "
9	"	0945	"	SB2-1-2	S	"	"	"
10	" "	0830	" "	FB2-1	B	Water	2	SW5030/8240
11	" "	0840	" "	EW2-1	B	Water	2	" "
12	" "	0845	" "	SB2-3-1	S	Soil	1	% Moisture
13	" "	0850	" "	SB2-3-2	S	Soil	1	% M
14	" "	0935	" "	SB2-1-1	S	Soil	1	% M
15	" "	0945	" "	SB2-1-2	S	" "	1	% M
16	" "	1015	" "	SB2-2-1	S	" "	1	% M
17	" "	1025	" "	SB2-2-2	S	" "	1	% M
18	" "	1130	" "	SB2-4-1	S	" "	1	% M
19	" "	1140	" "	SB2-4-2	S	" "	1	% M
20				TRIP BLANK #3	B		2	SW5030/8240

Column Total:

Signature & Affiliation PLEASE

Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
Brett [illegible] / SAIC	DP	12/13/88 1700	Good
DP	DP		
DP	DP		
DP	DPato / SAIC	12-14-88 1015	OK (wet)

SAIC / ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882334 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 2

Project: PORTLAND ANG

Reason for Transfer: ANALYSIS

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	12/13/88	1330	SITE 3	EW3-1	B	Water	2	SW5030/8240
2	" "	~~1340~~ 1320	" "	FB3-1	B	Water	2	" "
3	" "	1345	SITE 3	SB3-1-1	S	Soil	2	" "
4		1420	" "	SB3-3-1	S	" "	2	" "
5		1450		SB3-4-1	S	" "	2	" "
6		1545		SB3-2-1	S	" "	2	" "
7		1550		SB3-2-1R	R	" "	2	" "
8								
9	12/13/88	1345	SITE 3	SB3-1-1	S	Soil	1	PHC, %M
10		1545	"	SB3-2-1	S	" "	1	PHC, %M
11		1550	"	SB3-2-1R	R	"	1	PHC, %M
12		1450	"	SB3-4-1	S	" "	1	PHC, %M
13		~~1445~~ 1420	"	SB3-3-1	S	" "	1	PHC, %M
14								
15		1330	"	EW3-1	B	Water	1	PHC
16		1320	"	FB3-1	B	Water	1	PHC
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Brett [illegible]/SAIC	DP	12/13/88 1700	Good
	DP		
	DP		
DP	[illegible]/SAIC	12-14-88/1015	OK (wet)

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882335 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

00636

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 3

Project:

Reason for Transfer:

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	12/14/88	1400	PANG	SBBG 1-1	S	Soil	2	VOC
2	12/14/88	1400	PANG	SBBG 1-1	S	"	1	PHC, PCB, %M
3	12/14/88	1420	PANG	SB BG 1-2	S	"	2	VOC
4	12/14/88	1420	PANG	SB BG 1-2	S	"	1	PHC, PCB, %M
5	12/14/88	1445	PANG	SBBG 2-1	S	"	2	VOC
6	12/14/88	1445	PANG	SB BG 2-1	S	"	1	PHC, PCB, %M
7	12/14/88	1445	PANG	SBBG 2-1R	R	"	2	VOC
8	12/14/88	1445	PANG	SB BG 2-1R	R	"	1	PHC, PCB, %M
9	12/14/88	1525	PANG	SB BG 2-2	S	"	2	VOC
10	12/14/88	1525	PANG	SB BG 2-2	S	"	1	PHC, PCB, %M
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
[signature] /SAIC	DP	1700/12/14/88	good
~~Relinquished by/Affiliation:~~	Received by/Affiliation: DP	Date/Time:	Condition:
~~Relinquished by/Affiliation:~~	~~Received by/Affiliation:~~ DP	Date/Time:	Condition:
Relinquished by/Affiliation: DP	Received by/Affiliation: DPate/SAIC	Date/Time: 12-15-88/1040	Condition: OK (wet)

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882336 Page ____ of ____

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 4

Project: PORTLAND ANG

Reason for Transfer: Analysis

882343 SAMPLES CO-RD ↓

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	12/21/88	745	PANG	FB 4	B	water	2	VOCs
2	12/21/88	745	PANG	FB 4	B	water	1	metals
3	12/21/88	745	PANG	FB 4	B	Water	1	sulfate
4	~~12/21/88~~	~~745~~	~~PANG~~	~~FB4~~	~~B~~	~~water~~	~~1~~	~~Pet. Hydrocarbons~~
5	12/21/88	745	PANG	FB 4	B	water	1	PCBs
6	12/21/88	745	PANG	FB 4	B	water	1	Base Neutral/Acids
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
[signature] /SAIC	DP	12/21/88 1340	
Relinquished by/Affiliation:	Received by/Affiliation: DP	Date/Time:	Condition:
Relinquished by/Affiliation:	Received by/Affiliation: DP	Date/Time:	Condition:
Relinquished by/Affiliation: DP	Received by/Affiliation: [signature] /SAIC	Date/Time: 12-22-88 1400	Condition: Wet OK

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

SRG# 882343 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. 4

Project: Portland Air National Guard Base

Reason for Transfer: sample analysis

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	12/21/88	815	PANG	MW 2-1	S	water	2	VOC
2	12/21/88	815	PANG	MW 2-1	S	water	1	Pet HC
3	12/21/88	1000	PANG	MW5-2	S	water	2	VOC
4	12/21/88	1000	PANG	MW 5-2	S	water	1	Pet. HC
5	12/20/88	1235	PANG	SB 3-1-2	S	soil	1	PHC, % moisture
6	12/20/88	1310	PANG	SB 3-2-2	S	soil	1	PHC, % moisture
7	12/20/88	1315	PANG	SB 3-3-2	S	soil	1	PHC, % moisture
8	12/20/88	1345	PANG	SB 3-4-2	S	soil	1	PHC, % moisture
9	12/21/88	815	PANG	MW2-1	S	water	1	metals
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								882345
20								
Column Total:								882344

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Stuart Stren / SAIC	DP	12/21/88 1600	
~~Relinquished by/Affiliation:~~	~~Received by/Affiliation:~~ DP		
~~Relinquished by/Affiliation:~~	~~Received by/Affiliation:~~ DP		
Relinquished by/Affiliation: DP	Received by/Affiliation: DPatt / SAIC	12-22-88 1400	Wet ok

SAIC/ETG 13400-B Northup Way, Suite 38, Bellevue, Washington 98005 (206) 747-7899

Page ______ of ______

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

Shipment # 4

Sample Chain of Custody Log

Project : Portland ANG   Reason for Transfer : Sample Analysis

#	Sampling Date	Start Time	Sample Id.	RBS	Matrix	# Items	Comments
1	12/21/88	800	PANG EW-4	B	water	2	VOCs ✓
2	12/21/88	800	PANG EW-4	B	water	1	sulfides ✓
3	12/21/88	800	PANG EW-4	B	water	1	metals ✓
4	12/21/88	800	PANG EW-4	B	water	1	PCBs ✓
5	12/21/88	800	PANG EW-4	B	water	1	Pet HCs ✓
6	12/21/88	800	PANG EW-4	B	water	1	BNAs ✓

Released By [signature] SAIC 12/21/88

Rec'd by D Patt[signature] SAIC
12-22-88
1400

882344

all received intact.

PORTLAND ANG

882343

CHAIN-OF-CUSTODY

Sample ID	SAMPLE ID	DATE	TIME	MATRIX	No. CONTAINERS	ANALYSIS
92343 11	MW1-1	12/21/88	1100	Water	1 E	BNAs
	MW1-1	"	"	"	"	PCBs
	MW1-1	"	"	"	2	VOCs
	MW1-1	"	"	"	1	Metals
12	R1 (MW1-1)	"	"	"	1	metals replicate
13	R2 (MW1-1)	"	"	"	1	BNAs Rep
13	R2 (MW1-1)	"	"	"	1	PCBs Rep
13	R2 (MW1-1)	"	"	"	2	VOCs rep
14	FB4	12/21/88	0745	"	1	PHCs

Brut R. Fruier 12/21/88 1534

1 R2 are Replicates for MW1-1

Rec'd by DPater SAIC 12-22-88 1400

882343

CHAIN-OF-CUSTODY

Lab Sample ID	SAMPLE ID	DATE	TIME	MATRIX	No. of CONTAINERS	ANALYSIS
88234304	SB3-1-2	12/20/88	1235	Soil	2	VOC
05	SB3-2-2	12/20/88	1310	Soil	2	VOC
06	SB3-3-2	12/20/88	1315	Soil	2	VOC
07	SB3-4-2	12/20/88	1345	Soil	2	VOC
02	MW3-1	12/21/88	1200	Water	2	VOC
	MW3-1	12/21/88	1200	Water	1	PHC
03	R3(MW3-1)	12/21/88		Water	1	Replicate PHC
88234301	TB4	Trip Blank				VOC

Rec'd by D Patt SAIC
12-22-88
1400

882343

CHAIN-OF-CUSTODY

Lab Sample ID	SAMPLE ID	DATE	TIME	MATRIX	# of Containers	Analysis
88234309	MW5-1	12/21/88	0930	Water	1	SULFATE
↓	MW5-1	12/21/88	0930	"	1	METALS
10	R1 (MW5-1)	12/21/88			1	SULFATE
09	MW5-1	12/21/88	0930	Water	1	BNAs
↓	MW5-1	12/21/88	0930	Water	2	VOA
	~~MW5~~					

Brett R. Freun / SAIC

Rec'd by
[illegible] SAIC
12-22-88
1400

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. E1

Project: PORTLAND ANG

Reason for Transfer: Analysis

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	1/19/89	1430	SITE 1	FBE-1	B	Water	4 (1L)	PCBs SW3550/8080
2		1440		EWE-1	B	Water	2 (1L)	PCBs
3		1500		SBIE-1-1	S	Soil	1 (500ml)	PCBs
4		1510		SBIE-2-1	S	Soil		PCBs
5		1520		SBIE-3-1	S	Soil		PCBs
6		1540		SBIE-4-1	S	Soil		PCBs
7	1/19/89	—	—	RE-1	R	Soil		PCBs
8	1/20/89	0845	SITE 1	FBE-2	B	Water	2	VOCs SW5030/8240
9		0900		EWE-2	B	Water	2	VOCs
10		0910		MWIE-1	S	Water	2	VOCs
11		0915		RE-2	R	Water	2	VOCs
12	1/20/89	—		TBE-1	B	Water	2	VOCs SW5030/8240
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
Burt Lewis / SAIC	~~[illegible] Noel STC~~	1/20/89 0930	Good
~~Relinquished by / Affiliation:~~	Received by / Affiliation: [illegible] Noel	1-21-89 0900	Condition:
Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:
Relinquished by / Affiliation:	Received by / Affiliation:	Date/Time:	Condition:

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SRG# {890002 890003

Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record

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SAMPLE CHAIN OF CUSTODY LOG

Shipment No. E2

Project: PORTLAND ANG

Reason for Transfer: ANALYSIS

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	1/24/89	1245	SITE 1	FBE-3	B	Water	2	VOCs SW8240
2	|	1300	|	EWE-3	B	Water	2	|
3	|	1315	|	SBIE-17-2	S	Soil	1	|
4	|	—	trip blank	TBE-2	B	Water	2	|
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Brett R. Freier/SAIC		1/24/89 1700	GOOD
			DP
			DP
DP	D[illegible]/SAIC	1-25-89 0915	GOOD

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SRG# 890009 890010 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

72

00153

SAIC Science Applications International Corporation

SAMPLE CHAIN OF CUSTODY LOG

Shipment No. E3

Project: PORTLAND ANG

Reason for Transfer: Analysis

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	1/25/89	1320	SITE 1	EWE-4	B	Water	2	VOCs - SW8240
2	1/25/89	1330	SITE 1	SMWIE-2.5	S	Soil	1	VOCs - SW8240
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Brell Freier /SAIC		1/25/89 1580	Good
Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:

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SRG# ~~890013~~ 890014

Page 1 of 1

White - Return to Original Sampler (above address)

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00154

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SAMPLE CHAIN OF CUSTODY LOG

Shipment No. E4

Project: PORTLAND ANG

Reason for Transfer: ANALYSIS

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix / Media	# Items or Containers	Comments
1	1/26/89	1330	SITE 1	EWE-5	B	Water	2	VOCs; SW8240
2	1/26/89	1340		SBIE-11-1	S	Soil	1	VOCs; SW8240
3	1/26/89	1445		SBIE-16-2	S	Soil	1	
4	1/26/89	1530		SBIE-21-2	S	Soil	1	
5	1/26/89	—		TBE-3	B	Water	2	
6	1-26-89	N/A	N/A	RE-3	S DP 1-27-89	Soil	1	
7								
8								
9	Raw #6 filled out by Dipak P. 1-27-89							
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Burt R Freier/SAIC	1-27-89 DP	1600 1/26/89	Good
			1-27-89 DP
			1-27-89 DP
1-27-89 DP	D Patel / SAIC	1-27-89/1020	Good

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SRG# 890018 890019

Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

74

00155

SAIC Science Applications International Corporation	SAMPLE CHAIN OF CUSTODY LOG	Shipment No. E5

Project: PORTLAND ANG

Reason for Transfer: Analysis

	Sampling Date	Start Time	Sample Location	Sample ID	R-Rep B-Blk S-Sam	Matrix/ Media	# Items or Containers	Comments
1	1/27/89	1300	SITE 1	EWE-6	B	Water	1 *	VOCs ; SW8240
2	1/27/89	1315	SITE 1	MWIE-2	S	Water	2	VOCs ; SW8240
3	1/27/89	—	SITE 1	RE-4	~~S~~ R	Water	1 *	
4	1/27/89	—	—	TBE-4	B	Water	2	
5								
6								
7								
8			SC/AS → [illegible] only 1 [illegible]					
9				RE-4. [illegible]				
10								
11								
12								
13								
14								
15								
16								
17								
18	* Only 1 vial due to shortage of bottles; OK'd with Joe ~~Arant~~ Arlauskas							
19								
20								
Column Total:								

Signature & Affiliation PLEASE

Relinquished by/Affiliation:	Received by/Affiliation:	Date/Time:	Condition:
Brett K. Ewers /SAIC	DP	1/27/89 1330	Good
~~Relinquished by/Affiliation:~~	~~Received by/Affiliation:~~	Date/Time:	Condition: DP
~~Relinquished by/Affiliation:~~	~~Received by/Affiliation:~~	Date/Time:	Condition: DP
Relinquished by/Affiliation: DP	Received by/Affiliation: DPatty SAIC	0955/1-28-89	GOOD

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SRG#890020 Page 1 of 1

White - Return to Original Sampler (above address)
Yellow - Laboratory Record
Pink - Retained by Original Sampler

890174

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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 1 817 03 471 02 Project Mgr.: Daryl Jech
Project Name: Portland ANG
Project Location: Portland, OR
Client Name: HAZWRAP

Shipment No.: 1
Shipping Container No.: 1
Custody Seal No.: N/A
Date Shipped: 8/15/89
Carrier: FED Ex
Shipper: BRF/FED Ex
Shipper Bill No.: 3655409435

	Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: VOCs SW8240	PHCs ASTM D3328	Metals (Cr, Cd, Zn, Ni, Pb)	%M	Containers: 250 mL / VOCs	250 mL / PHC	250 mL / metals	Ziploc Bag	40 mL VOA vials	1L Amber Jug (PHC)	1L Plastic (metals)	Comments
01	SITE 4	S4-1	N/A	Sed	8/15/89	0915	BRF	1	1	1	1	1	1	1	1				RECEIVED 2 S4-1 ZIPLOC BAGS R.S. 8/16/89
02		S4-2				0945	BRF	1	1	1	1	1	1	1	1				DID NOT RECEIVE S4-2 ZIPLOC BAG R.S. 8/16/89
03		S4-3				1020	BRF	1	1	1	1	1	1	1	1				
04		S4-4				1140	BRF	1	1	1	1	1	1	1	1				
05		S4-5				1050	BRF	1	1	1	1	1	1	1	1				
06		S4-6				1210	BRF	1	1	1	1	1	1	1	1				
07		S4-7				1315	BRF	1	1	1	1	1	1	1	1				
08		FBS		Water		0900	BRF	1	1	1						2	1	1	
09		EWS		Water		1445	BRF	1	1	1						2	1	1	
11		Trip Blank #01						1								1			
10		D-1			8/16/89			1	1	1	1	1	1	1	1				WAS NOT ON COC BUT WAS RECEIVED
																			Custody Seal intact S.V. 8/16

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett R. [illegible]	Signature: R. [illegible]	Signature:	Signature:
Date/Time: 8/15/89 1530	Date/Time: 8/16/89 / 11:00	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 18170347102 Project Mgr.: Daryl Jech
Project Name: PORTLAND ANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP 890177

Shipment No.: 02
Shipping Container No.: 02-
Custody Seal No.: N/A
Date Shipped: 8/16/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.: 3655409730

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: Purgeable halocarbons/aromatics (SW8240)	BNAs (SW8270)	Metals (Cd, Cr, Pb, Ni, Zn)	% M	PAHs (ASTM D3328)	Containers: 40 ml VOA vials	250 ml wide mouth	250 ml wide mouth	plastic bag	250 ml wide mouth	4 L amber jug	4 L amber jug	1 L plastic	Comments
SITE 5	15417FB6	N/A	H_2O	8/16/89	0815	BRF, SSS	1	1	1		1	2					1	1	1	Field Blank
01	SB5-1-1	1'	Soil		0830		1	1	1	1		2	1	1	1					
02	SB5-1-2	3'			0845		1	1	1	1		2	1	1	1					
03	SB5-2-1	1'			0900		1	1	1	1		2	1	1	1					
04	SB5-2-2	3'			0910		1	1	1	1		2	1	1	1					
05	SB5-3-1	1'			0930		1	1	1	1		2	1	1	1					
06	SB5-3-2	3'			0940		1	1	1	1		2	1	1	1					
07	SB5-4-1	1'			1010		1	1	1	1		2	1	1	1					
08	SB5-4-2	3'			1020		1	1	1	1		2	1	1	1					
09	SB5-5-1	1'			1120		1	1	1	1		2	1	1	1					
10	SB5-5-2	3'			1130		1	1	1	1		2	1	1	1					
11	SB5-6-1	1'			1150		1	1	1	1		2	1	1	1					
12	SB5-6-2	3'			1200		1	1	1	1		2	1	1	1					
16	D2						1	1	1	1		2	1	1	1					Duplicate
13	SB5-7-1	6'			1250		1			1	1	2			1	1				
14	SB5-7-2	8'			1300		1			1	1	2			1	1				

RELINQUISHED BY:	RECEIVED BY: CUSTODY SEAL INTACT R.S. 8/17/89	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett R. Freies	Signature: R. S[illegible]	Signature:	Signature:
Date/Time: 8/16/89 1730	Date/Time: 8/17/89 11:30	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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2 of 2

MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 1 017 03 47102 Project Mgr.: Daryl Tech

Project Name: PORTLAND ANG 890176

Project Location: PORTLAND, OR

Client Name: HAZWRAP

Shipment No. 02
Shipping Container No. 02
Custody Seal No N/A
Date Shipped 8/16/89
Carrier FED EX
Shipper FED EX
Shipper Bill No. 365540973D

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: VOCs (purgeables) SW8240	BNAs (SW8270)	Metals (Cd, Cr, Fe, Pb, Ni, Zn)	% M	PHCs (ASTM D3328)	Containers: 40mL VOA vials	250mL wide mouth	250mL wide mouth	plastic bag	250mL wide mouth	4L Amber jug	4L Amber jug	1L plastic	Comments
SITE 5 01	SB5-8-1	6'	Soil	8/16/89	1340	BRF & SS	1			1	1	2			1	1				R.S. 8/17/89
02	SB5-8-2	10'			1400		1			1	1	2			1	1				
03	SB5-9-1	6'			~~1445~~		1			1	1	2			1	1				
04	SB5-9-2	8'			1500		1			1	1	2			1	1				
05	SB5-10-1	6'			1515		1			1	1	2			1	1				
06	SB5-10-2	9'			1530		1			1	1	2			1	1				
07	D3.						1			1	1	2			1	1				Duplicate
07	#02 TRIPBLANK	R.S. 8/17/89					1					1								

CHAIN OF CUSTODY SEAL INTACT R.S. 8/17/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett Travis	Signature: R. Shaw	Signature:	Signature:
Date/Time: 8/16/89 1730	Date/Time: 8/17/89 11:30	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 1 817 03 471 02 Project Mgr.: Daryl Jech
Project Name: PORTLAND ANG
Project Location: PORTLAND, OR 890176
Client Name: HAZWRAP

Shipment No.: 02
Shipping Container No.: 03
Custody Seal No.: N/A
Date Shipped: 8/16/89
Carrier: FED EX
Shipper: FED EX
Shipper Bill No.: 3655409750

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: Purgeables (SW8240)	BNAs (SW8270)	PHCs (ASTM D3328)	Metals (Cd, Cu, Fe, Pb, Zn, Ni)	% Moisture	Containers: 40 mL VOAs	4L Amber	4L Amber	1L Plastic	Ziploc	Comments
SITE 508	EW6	N/A	Water	8/16/89	1630	SStrum	1	1	1	1		2	1	1	1		Equip. Wash
	SBS-8-1	|	Soil	|	1340	BRF					1					1	PLASTIC BAGS ALREADY LISTED
	SBS-8-2	|	Soil	|	1400	BRF					1					1	ON OTHER SEC. (ATTACHED

CUSTODY SEAL INTACT R.S. 8/17/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett [signature]	Signature: R. S[signature]	Signature:	Signature:
Date/Time: 8/16/89 1730	Date/Time: 8/17/89 1130	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

00446

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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD 890185

Project No.: 1 817 03 471 02 Project Mgr.: Daryl Jech
Project Name: PORTLAND ANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP

Shipment No.: 03
Shipping Container No.: 04
Custody Seal No.: N/A
Date Shipped: 8/17/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.: 365540572[illegible]

	Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	PHCs (ASTM D3328)	Pb (SW7421)	PHCs (ASTM D3328)	% Moisture RECEIVED RS 8/18/89	250 ml amber wide-mouth	250 ml amber wide-mouth	1L amber jug	Comments
01	SITE 7	SB7-1-1	1'	Soil	8/17/89	0940	BEF & SS	i	i		✓	1	1		
02		SB7-1-2	5'			0950		i	i		✓	1	1		
03		SB7-1-3	10'			1000		i	i		✓	1	1		
04		D4	—			—		i	i		✓	1	1		Duplicate
05		EW7				1015				i				1	Equip. Wash

% Moisture Ziploc Received, Not Marked on COC R.S. 8/18/89

Custody Seal In Tact R.S. 8/18/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brad Fucci	Signature: R. Sims	Signature:	Signature:
Date/Time: 8/17/89 / 1400	Date/Time: 8/18/89 1600	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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Bothell, Washington 98011
206/485-5800 • FAX: 485-5566

MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 1 817 03 47102 Project Mgr.: DARYL SECH
Project Name: OREGON ANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP 890197

Shipment No. 04
Shipping Container No.: 05
Custody Seal No.: N/A
Date Shipped: 8/22/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.:

	Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	BNAs (SW8270)	Metals (Pb, Fe, Cd, Cr, Ni, Zn)	% Moisture	BNAs (SW8270)	metals (Cd, Cr, Ni, Zn)	250 mL Amber	250 mL Amber	Ziploc	4L Amber	1L Plastic	Comments
01	Background	SBBG-1	2'	Soil	8/22/89	1145	BRF & SS	1	1	1			1	1	1			
02	|	SBBG-2	8'	|	|	1220	|	1	1	1			1	1	1			
03	|	DS	|	|	|		|	1	1	1			1	1	1			duplicate
04	|	FB87	|	Water	|	1115	|				1	1				1	1	
05		EW8	|	Water	|		|				1	1				1	1	

CUSTODY SEAL INTACT RD 8/23/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature:	Signature: [signature]	Signature: [signature]
Date/Time:	Date/Time:	Date/Time: 315 pm 8/22	Date/Time: 8/23/89 / 12:30
Affiliation:	Affiliation:	Affiliation: SAIC	Affiliation: SAIC

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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Bothell, Washington 98011
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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 1817 03 47102 Project Mgr.: DAEY, SECH
Project Name: PANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP 890323

Shipment No.: 04
Shipping Container No.: 05
Custody Seal No.: N/A
Date Shipped: 8/28/89
Carrier: FED EX
Shipper: FED EX
Shipper Bill No.: 3655409450

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: ~~TOCs (SW8240)~~	PHCs (ASTM D3328)	Metals (Cd, Cr, Zn, Ni, Pb)	Containers: ~~40ml VOA vials~~	4L Amber Jug	1L Plastic / HNO3	Comments
SITE 2	04 MW2-1-1	N/A	H_2O	8/28/89	1115	BRF & SS		1	1		1	1	DID NOT RECEIVE RS.
	06 DB		H_2O	8/28/89		BRF & SS		1	1		1	1	Duplicate
	04 MW2-2-1		H_2O	8/28/89	1118			1	1		1	1	RECEIVED THIS RS 8/30

CUSTODY SEAL INTACT RS 8/30/89
pH<2 ON METALS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett Frei[illegible]	Signature: R S[illegible]	Signature:	Signature:
Date/Time: 8/28/89 / 1600	Date/Time: 8/30/89 / 10:00	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

SAIC
18706 North Creek Parkway, Suite 110
Bothell, Washington 98011
206/485-5800 • FAX: 485-5566

MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 817034710 2 Project Mgr.: DARYL JECH
Project Name: PANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP

830223

Shipment No.: 04
Shipping Container No.: 06
Custody Seal No.: N/A
Date Shipped: 8/28/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.: 365540945

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	BNAs (SW8270)	PCBs (SW8080)	PHCs (ASTM D3328)	Metals (Cd, Cr, Zn, Ni, Fe, Pb)	Sulfates	4L Amber	4L Amber	4L Amber	1L Plastic/HNO_3	1L Plastic	Comments
Background	03 MWBG-1	N/A	H_2O	8/28/89	0800	BRF & SS	1	1	1	1	1	1	1	1	1	1	~~[illegible]~~ R.S. 8/30/89
	05 D6		H_2O	8/28/89		BRF & SS	1	1	1	1	1	1	1	1	1	1	Duplicate

CUSTODY SEAL INTACT R.S 8/30/89

pH < 2 ON METALS R.S. 8/30/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett [illegible]	Signature: R. Shaw	Signature:	Signature:
Date/Time: 8/28/89 / 1630	Date/Time: 8/30/89 10:00	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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Bothell, Washington 98011
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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 817 03 47102 Project Mgr.: DARYL BECH
Project Name: PANG
Project Location: PORTLAND, OR 890324
Client Name: HAZWRAP

Shipment No.: 04
Shipping Container No.: 07
Custody Seal No.: N/A
Date Shipped: 8/28/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.: 3655409450

	Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	VOCs (SW8240)	BNAs (SW8270)	Pb (SW7421)	Ignitability	40 ml vials	4L Amber	1L Plastic/HNO3	Small glass jar	Comments
09	SITE 7	MW7-1-1	N/A	H_2O	8/28/89	0920	BRF & SS	1	1	1		2	1	1		
10		MW7-2-1				0905		1	1	1		2	1	1		BNA BOTTLE 2/3 IS MARKED MW7-2
11		MW7-3-1				1000		1	1	1		2	1	1		
12		MW7-4-1				1030		1	1	1		2	1	1		
03		D7				—		1	1	1		2	1	1		Duplicate
02		D6				—		1				2				Duplicate
04		D8				—		1				2				Duplicate
07		MWBG-1				0800		1				2				
08		MW2-2-1				1115		1				2				
06		FB8				0730		1				2				Field Blank
05		EW9				1300		1				2				Equip. Rinse
01		DMW1-1				1415		1			1	2			1	
13		Trip Blank						1				1				

TEST NOT MARKED R.S. 8/30/89

CUSTODY SEAL INTACT R.S. 8/30/89

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett Lewis	Signature: R. S[illegible]	Signature:	Signature:
Date/Time: 8/28/89 1630	Date/Time: 8/30/89 10:15	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

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MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 817 03 471 02 Project Mgr: DARYL JECH
Project Name: PANG
Project Location: PORTLAND, OR
Client Name: HAZWRAP 890323

Shipment No.: 04
Shipping Container No.: 08
Custody Seal No.: N/A
Date Shipped: 8/28/89
Carrier: FED Ex
Shipper: FED Ex
Shipper Bill No.: 3655409450

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: BNAs (SW8270)	PCBs (SW8080)	PHCs (ASTM D3328)	Metals (Cd, Cr, Zn, Ni, Fe, Pb)	Sulfates	Containers: 4L Amber	4L Amber	4L Amber	1l Plastic/HNO3	1L Plastic TF	Comments
— 01	FB8	N/A	H2O	8/28/89	0800	BRF & SS	1	1	1	1	1	1	1	1	1	1	Field Blank
— 02	EW9	1	1	1	1300	11	1	1	1	1	1	1	1	1	1	1	Equip. Rinse

"CUSTODY SEAL INTACT. R. 8/30/89
pH < 2 ON METALS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: Brett Freitag	Signature: R. S[illegible]	Signature:	Signature:
Date/Time: 8/28/89 / 1630	Date/Time: 8/30/89 10:00	Date/Time:	Date/Time:
Affiliation: SAIC	Affiliation: SAIC	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler